POWER

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Exposition Extortion

AMONG the exhibitors whose displays make mechanical shows possible, there is much discussion and uncertainty as to the extent to which participation in such exhibitions is warranted.

To considerations of the establishment and maintenance of prestige, opportunities of meeting possible purchasers and present users of their wares, is added that of the expense and annoyance inflicted by the impositions of the concessionaires.

At a recent show of this sort one of the exhibitors had provided hangings to form a background for his exhibit. They were in six panels, each held up by eight tacks at the top.

When he started to hang them, he was told that he was encroaching upon the prerogatives of the decorator, who demanded twenty dollars for the job, but finally accepted two dollars and a half for allowing one of his men to drive forty-eight tacks.

An exhibitor, starting to screw a small nickel-plated gage and an oil cup onto the machine that he was exhibiting, was accosted with a gruff "Say! How do you get that way? You're no pipefitter, are yer?" And for this finger-fit job of a few minutes, involving no skill and no element of safety, for the fittings were simply for show, he was mulcted another hour's work at two-fifty.

A small turbine was shown with the top of the casing turned back against a pipe rail. Any of the men in charge of the exhibit could have put up the support in a few minutes, but it had to be done at exposition rates by the accredited pipefitter.

Quick-drying white enamel had been brought to paint the inside of the casing, but the individual with the painting privilege was on hand to see that nobody but his men wielded a paint brush in that hall, and insisted upon furnishing his own paint, inferior for the purpose.

The advantages of taking part in such occasions have got to be demonstrably great to induce men to subject themselves voluntarily a second time to such indignities and imposition.

F. R. Low

Boston's Statler Hotel

Generates Power in Winter

Purchases Power in Summer

THE STATLER, Boston's newest hotel, is the largest in New England. A 750-kilowatt direct-current generator has been installed for winter use. Extraordinary precautions insure continuous service

MR. E. M. STATLER has just given to Boston a new hotel of this famous chain, which now covers Detroit, St. Louis, Cleveland, Buffalo and New York City (Hotel Pennsylvania). It is the largest hotel in New England, with 1,300 guest rooms and 1,300 private baths, and incorporates all that is new in modern hotel construction.

Its facilities include a ballroom, main dining room, five private dining rooms, lunchroom, sandwich shop and banquet hall, together with unusually extensive laundry and kitchen facilities. The structure includes a good-sized office building.

For heating, a vacuum-return-line low-pressure steam system has been installed. No attempt will be made to describe the heating and ventilating system in detail. A few general facts and figures will, however, be helpful in understanding the problem under consideration.

The ventilation layout comprises thirteen supply systems and fourteen exhaust systems. The larger ones are as follows, the figures being maximum capacity in cubic feet per minute:

	Supply	Exhaust
Engine room	61,000	85,000
Laundry	63,000	92,000
Kitchen	80,000	118,000
Ballroom, dining room and lobby	56,000	81,000
	260,000	376,000

Additional fans for other services bring the total capacity up to 465,000 cu.ft. air supply and 645,000 cu.ft. exhaust.

Dual-service units have been tried here for the first time by the Statler Hotel Company. These will make it possible to direct maximum ventilating capacity into any system as needed.

In addition to heating and ventilating this huge establishment, provision had to be made for the many special services that are essential to the modern hotel. Among these are refrigeration (for ice water, ice, cold storage, and ice-cream manufacture), pneumatic message service, vacuum cleaning service, compressed air for mechanical appliances and cleaning, hot water (for guestrooms, kitchen, laundry and office building) and so on.

The total hot-water capacity of the various heaters is 55,000 gal. per hour, although it is not likely that all of them will ever be operated to capacity at the same time. This heater capacity is divided up as follows:

	Gal. per Hour
2 guestroom heaters, totaling	27,600
1 kitchen heater	10,000
1 laundry heater	13,800
1 office building heater	3,600
Total	55,000

The estimated total steam load, assuming all steam-consuming apparatus to be operating at full load simultaneously, is made up as follows:

	Lb. per Hour
93,000 sq.ft. of radiators	30,000
380,000 cu.ft. per min. air supply	35,000
55,000 gal. per hr. hot-water capacity	57,000
Laundry steam	6,000
Kitchen steam	6,000
Power-plant loss	4,500
Total	138,500

The total maximum steam demand, however, is estimated not to exceed 70,000 lb. per hour, giving a diversity factor of about 50 per cent.

The total steam used per year is estimated as follows:

	Lb. per Yr.
Laundry	11,000,000
Kitchen	19,400,000
Hot water	42,300,000
Heating	86,900,000
Power generating losses	10,000,000
Stoker steam and soot blowing	2,000,000
	171,600,000

In designing this plant, much study was given to the problem of securing the needed heat and electricity at

the lowest over-all rate. Eight reports in all were received from consulting engineers, operating engineers, [illegible] builders and the public service company. As is frequently the case under similar circumstances no two reports agreed. The two extremes are represented by opinions that may be summarized as follows:

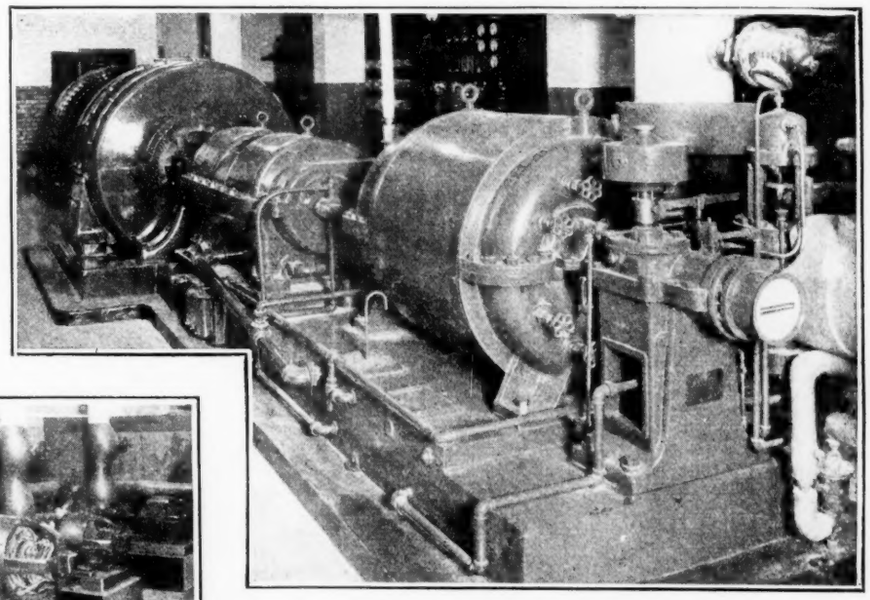
1. That a power plant could never pay and that it would be far cheaper to generate steam for heating service only and buy all electric current for light and power.

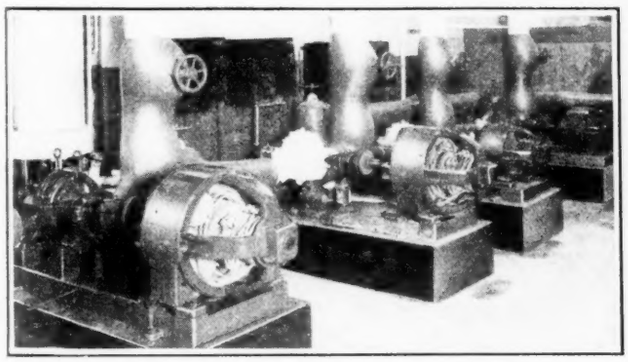
2. That a power plant was absolutely essential for economic operation and would pay for itself in a few years.

Such contradictory opinions necessitated close study to arrive at the best solution. After considering the matter for many months, the engineers representing the owner reached a decision intermediate between the two extremes and novel in some respects at least. The final result was substantially as follows:

Fig. 1 (below)—As is the case with all the rotating auxiliaries, the four brine pumps are driven by direct-current motors

Fig. 2 (right)—In foreground is 750-kw. direct-current turbine generator and beyond it the 500-kva. motor-generator set





The Boston Edison Company entered into an arrangement to supply 13,800-volt 60-cycle alternating-current service under its co-operative wholesale rate "N." An outline of the principal features of this rate is given near the end of this article.

Lighting is supplied at 115 volts (alternating current). A 500-kw. motor-generator set will produce direct current at 230 volts for power uses. The connected load, both lighting and power, is estimated at 2,000 hp. It is expected that about 3,000,000 kw.-hr. will be used yearly from this outside connection.

The hotel will install one 750-kw. direct-current turbine generator. This will be operated during the heating season with an estimated annual production of 1,200,000 kw.-hr. during this period.

The estimated maximum demand is about equal to the capacity of this turbine generator. Since as much as 1,000 kw. may be drawn from the outside connection, the total available capacity is 1,750 kw., nearly 2½ times the maximum demand. With such a reserve interruptions in service appear almost impossible.

The analysis[1] that led to this arrangement is of considerable interest, and its main points will now be outlined.

Assuming first a complete power plant designed for year-round use and equipped with reciprocating engines, a steam rate of 35 lb. per kw.-hr. is about as good as could be expected. It is estimated that the combined hotel and office building will require about 4,200,000 kw.-hr. per year, which would result in the production of $4{,}200{,}000 \times 35 = 147{,}000{,}000$ lb. of exhaust steam yearly if all generated locally.

The average daily current consumption does not vary much in a modern metropolitan hotel, because the increased winter lighting load is nearly balanced by the greater ventilating load in the summer. On the other hand, the shapes of the daily load curves in summer and winter are quite different.

Assume that a power plant was installed and operated during the summer months (taken at 155 days). There would be produced during that period $\frac{155}{365} \times 147{,}000{,}000$ = about 62,000,000 lb. of exhaust steam, of which only 17,000,000 lb. could be used for hot water.

During the summer the greater part of the exhaust steam produced would have to be blown to waste. With an engine steam rate of 35 lb. per kw.-hr. and a steam charge of 70c. per thousand pounds, a kilowatt-hour would cost $0.035 \times 70\text{c.} = 2.45\text{c.}$ for steam alone. Adding estimates for interest, maintenance, depreciation, labor, ventilation and oil, and giving a credit for the exhaust steam usable in summer (about 25 per cent), the net cost of the average kilowatt-hour would be about 2.7c. Since energy could be purchased at a much lower figure than this, it was concluded that a power plant could not possibly pay in the summer.[2]

A similar analysis for winter conditions gave an

[1] The particular analysis given here is based largely on a paper delivered recently in Boston by A. K. Ohmes of Tenney & Ohmes.

[2] This point is discussed further after considering the advisability of winter operation.

entirely different result. During the seven winter months (210 days) the exhaust steam would total $\frac{210}{365} \times 147{,}000{,}000 =$ about 84,000,000 lb. The estimated steam demand for this period is 112,000,000 lb., leaving some margin for failure of heat and power loads to synchronize.

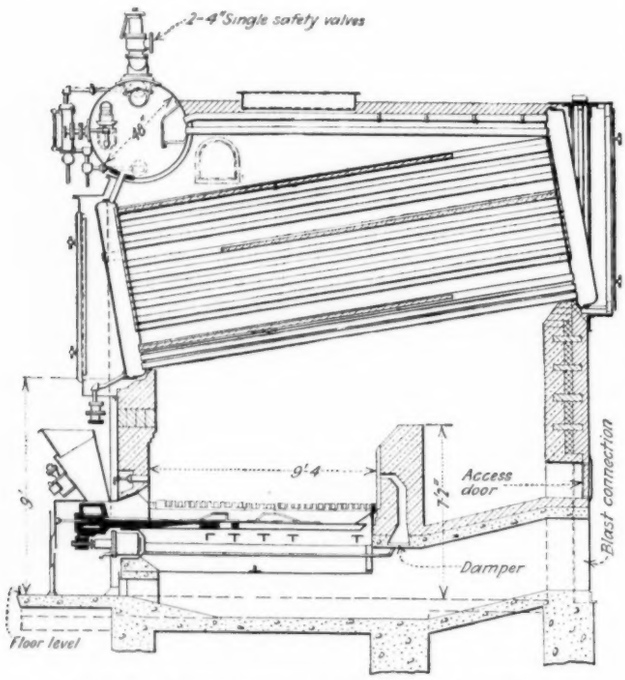


Fig. 3—Cross-section of boiler and setting

Assuming perfect synchronization, a steam rate of 112,000,000 ÷ 2,420,000[3] = 46.3 lb. per kw.-hr., would involve no waste of exhaust steam. Study of estimated steam and power demand curves for a typical winter day based on experience at other hotels, indicated that the two curves follow each other to a surprising extent. This being the case, and a water rate of less than 46 lb. per kw.-hr. being easily obtainable with a non-condensing turbine of this size, it was decided to use such a unit, because it would cost less than an engine-driven unit and occupy less space.

If, in generating one kilowatt-hour the liberal assumption is made that heat is removed from the steam equivalent to 6 lb. per kilowatt-hour, the power produced per 1,000 lb. of steam actually *consumed* would amount to 1,000 ÷ 6 = 167 kw.-hr. The steam cost per kilowatt-hour would then be 70c. ÷ 167 = 0.42c.

Allowing the ample figure of $35,000 for installation cost and 12 per cent for fixed charges, the yearly cost of the installation would be $35,000 × 0.12 = $4,200. The turbine generator can be readily counted upon to generate 1,200,000 kw.-hr. during the heating season each year, which would mean a fixed charge of $4,200 ÷ 1,200,000 = $0.0035 = 0.35c. per kw.-hr. The total cost comes to 0.42 + 0.35 = 0.77c. per kw.-hr., or a saving of approximately one cent per kilowatt-hour over the cost of purchased current. This saving amounts to $12,000 a year, which would pay for the unit in three years.

Allowing for some error in the estimated figures and for reasonable differences of opinion, it seems clear that purchased current is cheaper in the summer and "home-made" current in the winter, at least to the extent that the resulting exhaust can be utilized.

One point requires further comment. In the preceding analysis to determine the economy of operating a turbine-generator during the summer, such items of overhead as interest, depreciation, maintenance, labor, ventilation and oil were added in. If, however, a turbine is to be installed for winter use in any case, it is clear that its summer operation would not result in any additional cost for interest and depreciation. Labor cost might possibly be increased, and there would doubtless be some extra expense for oil and ventilation.

Thus it is seen that the "cost" to be used in determining the advisability of summer operation should be less than the 2.7c. per kilowatt previously figured. However, when the fixed charges are eliminated there is still a substantial margin in favor of purchased current during the summer.

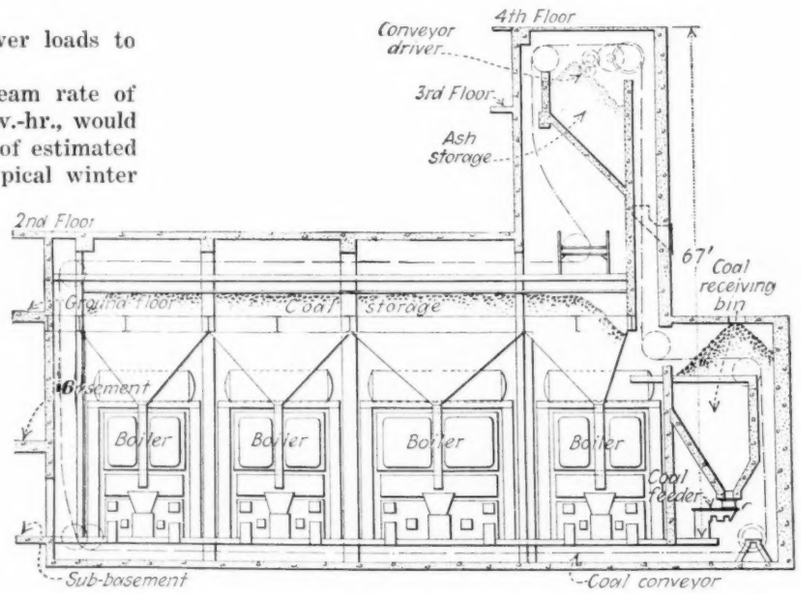


Fig. 4—Elevation of boiler room and coal- and ash-handling equipment

There are four stoker-fired water-tube boilers, two of 6,900 sq.ft., one of 6,220 sq.ft. and one of 4,560 sq.ft.

While the economic analysis of the problems encountered in designing this plant is considered of greater interest than a detailed description of the apparatus, a brief summary of the equipment follows:

The general arrangement of the boiler room and coal-handling equipment is shown in Fig. 4. Of the four

[3] This is the current consumption during the winter months = $4{,}200{,}000 \times \frac{210}{365} = 2{,}420{,}000$ kw. hr.

cross-drum, water-tube boilers, two have 6,900 sq.ft. of water-heating surface each. The heating surfaces of the other two boilers are 6,220 sq.ft. and 4,560 sq.ft. respectively.

The bucket conveyor has a capacity of 20 tons of coal per hour. When coal is not being handled, the same conveyor is used to carry off the ashes, which are pulled out by hand to gratings over the conveyor. New River, run-of-mine coal is burned, fired with underfeed stokers of the center-feed type.

The boilers have individual motor-driven forced-draft

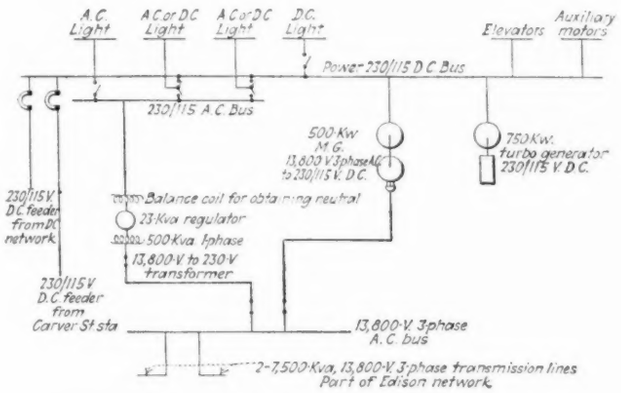

A.C. Light
A.C. or D.C. Light
A.C. or D.C. Light
D.C. Light
Elevators
Auxiliary motors
Power-230/115 D.C. Bus
230/115 A.C. Bus
500 Kw M.G. 13,800 V. 3 phase A.C. to 230/115 V. D.C.
750 Kw. turbo generator 230/115 V. D.C.
230/115 V. D.C. feeder from D.C. network
Balance coil for obtaining neutral
23 Kva regulator
500 Kva. 1 phase 13,800 V. to 230 V. transformer
230/115 V. D.C. feeder from Carver St. sta.
13,800 V. 3 phase A.C. bus
2-7,500 Kva, 13,800 V. 3 phase transmission lines Part of Edison network.

Fig. 5—One-line diagram showing how continuous electrical service is insured

fans. There are two steam-driven reciprocating vacuum pumps for the heating system, two simplex feed pumps, two feed-water filters and a closed-type feed-water heater. All motors for auxiliary drive are direct-current, 230-volt. All essential auxiliaries are in duplicate to insure uninterrupted service.

The turbine, running at 3,600 r.p.m., drives a 750-kw. 230-volt direct-current generator through a four-to-one reduction gear.

A brief outline of the system by which electrical service is insured may be of interest. A substation in a corner of the engine room is fed by two 7,500-kva. 13,800-volt three-phase transmission lines of the Edison network. Through a 500-kva. transformer these supply a 230/115-volt alternating-current bus which at all times furnishes the office building lighting, and may also supply most of the hotel lighting system if desired.

All power for motors, including elevators, ventilating fans, ammonia compressors, power-plant auxiliaries, etc., is taken from a three-wire 230/115-volt direct-current bus.

A portion of the lighting load is permanently supplied from this bus, while other portions may be supplied either from this or from the alternating-current bus. The supply of power to this direct-current bus is so varied as to make interruption of service almost inconceivable.

First is the 500-kva. motor-generator set, its 13,800-volt synchronous motor being started from the direct-current end. The same bus is fed by the 750-kva. turbine generator. As further insurance against interruptions, the bus may be connected to the Edison Co. direct-current system through two different feeders. The general arrangement is made clear by Fig. 5.

Refrigeration is provided by three ammonia compressors: One 75-ton, motor-driven; one 65-ton, Corliss-engine driven; and one 35-ton, driven by a simple engine. The steam consumption of auxiliaries was not considered of importance because the steam requirements for hot water, feed heating, kitchen, etc., will exceed the available exhaust at all times, summer[1] and winter.

Other refrigerating equipment includes four motor-driven brine pumps, ammonia condensers and receiver, accumulator, drinking-water pumps and cooler, etc. There are five hot-water heaters. As already pointed out, the steam demand of these heaters is comparable with that of the heating system.

The engine room contains two motor-driven exhausters for the vacuum cleaning system, and two pneumatic-tube machines, also motor-driven. There are two air compressors, one motor-driven and one steam-operated.

Power-plant engineers will be interested to note that exhaust steam will be used to supply plate warmers and certain other kitchen equipment for which it has previously been the custom to use live steam.

Mention has already been made of the fact that summer power and a certain amount of off-peak power in the winter will be obtained from the Boston Edison Company through an agreement made under their standard co-operative wholesale rate "N." This rate is available to customers who take high-tension alternating-current service and control other sources of power which are kept in readiness for operation upon reason-

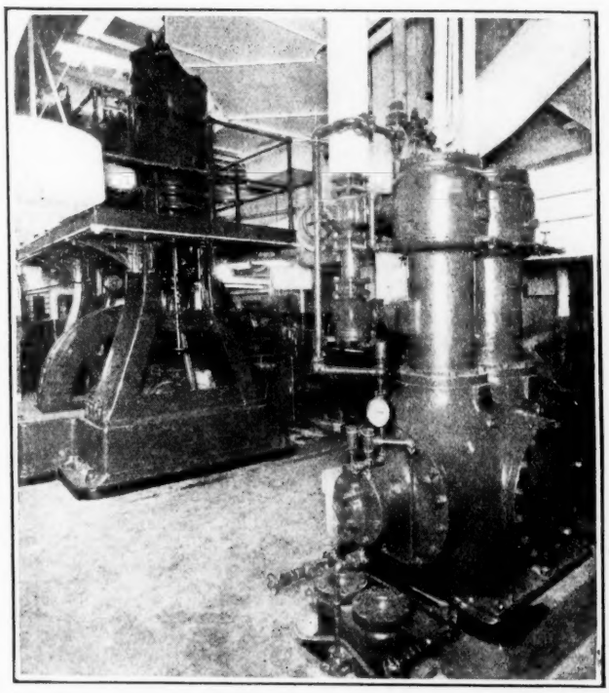


Fig. 6—Two of the three ammonia compressors

able notice from the company, and who furnish at their own expense, such breakers, time switches, etc., as provide for the intended limitations of service under this rate.

The total charge is in several parts. The first is a straight energy charge on the basis of 2c. per kilowatt-hour plus coal charge for the first 30,000 kw.-hr. per

[1] It will be recalled that the turbine it not to be operated during the summer.

month, 1c. for the next 70,000 kw.-hr., 0.8c. for the next 900,000 kw.-hr., 0.7c. for the next 2,000,000 kw.-hr. and 0.55c. for the excess. In each case an additional coal charge computed in a specified manner is applied. During 1926 it amounted to about 1.23 mills per kw.-hr. for high-tension service.

On or before October 1 of each year the company notifies its customers, under the rate, what peak hours, if any, will obtain during the succeeding winter months. This peak period is usually from 3 p.m. to 6 p.m. from October 15 to January 15, excluding Saturdays, Sundays and holidays. If the customer operates his plant during peak hours, another and lower schedule of energy

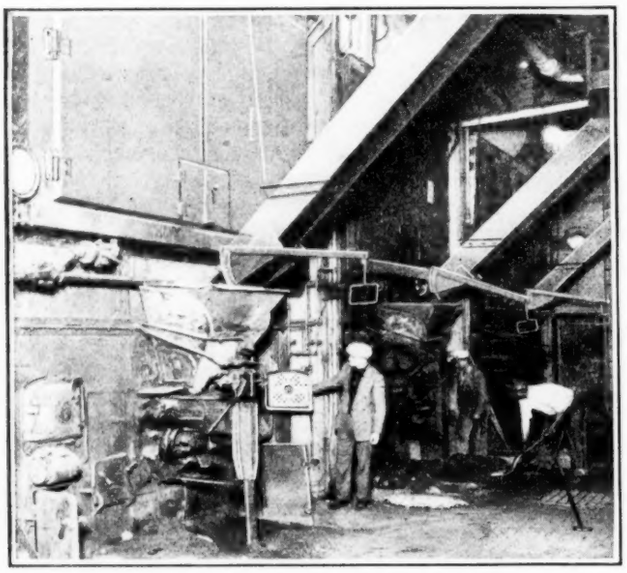


Fig. 7—Three of the four boilers
Note floor gratings for ash removal

rate applies during the entire period from October 15 to January 15. There is also a demand charge for kilowatts of service, if any is taken by the customer at any time in excess of the idle capacity of his plant, or for any kilowatts of service taken during peak hours. Low power factor is penalized by a special charge of 1½ mills each for reactive kilowatt-hours in excess of 75 per cent of the effective kilowatt-hours. A minimum charge of $6,000 per year, payable monthly, adjusted yearly, is made under this rate.

In conclusion it is worth pointing out that Mr. Statler's interest in his hotels is by no means restricted to finance and business management. He has personally directed the designing and planning of all his houses and has given much attention to the engineering department. His consultations with the engineers were an important factor in determining the arrangements made to insure continuous service of light, power, heat, refrigeration, etc., at minimum cost.

Power is indebted to H. B. Callis, of the Statler Hotel Company, for permission to write this article, and to A. K. Ohmes, of Tenney & Ohmes, Inc., consulting engineers, for the outline of the heat-power analysis as given in the first part of the article.

The explanation of rate "N" is based on information supplied by L. R. Wallis, of the Edison Electric Illuminating Company of Boston.

Soapsuds Reduces Air-Compressor Maintenance

By A. B. Newell

WHILE the multi-stage high-pressure air compressor, such as is used to pump injection air for the Diesel engine, is not troublesome, it demands, in common with all other machinery, a certain amount of attention in the form of routine work to keep it working correctly. This work is mostly in connection with the valves, the life of which depends to a great extent upon methods of operation and maintenance.

Over-lubrication is responsible for more air-compressor trouble than any one other item connected with its operation. It is characteristic of the average engineer to feel a certain degree of security in the thought that he is feeding sufficient oil to insure against any possibility of having a cylinder, bearing or any other working part run dry. It is not lack of knowledge of what the results will be, for he accepts the fact that he will cause a certain amount of carbonization and will have to spend quite a bit more time cleaning valves than would be the case if he kept his oil down to a minimum amount. He is willing to do the extra work in order to be safe. He understands his job well enough not to feed oil in such excess as to cause explosions.

I do not contend that this average practice is bad practice, although I do believe that it pays to keep reducing the oil supply until carbon formations on the valves have been reduced to a very small amount.

Deposits Not All Carbon

Not all deposits within the compressor are carbon, for impurities in the atmosphere when taken in also form deposits which, when mixed with oil and carbon greatly resemble the latter and must also be removed from time to time.

These carbon deposits, when allowed to become too heavy on the valves and cages, have pronounced detrimental effects. One is the stoppage of the air passages with subsequent increases of initial pressure and temperature. Another is the sluggish action of the valves, which sometimes permits the air to whipsaw back and forth. A third is actual damage to the valves and seats when hard pieces of carbon lodge between them, and the working pressure is applied. The combined results of these various conditions tend to reduce the over-all efficiency of the compressor in a proportion somewhat similar to their extent. Associated with carbon formations on the valves is a similar formation on the inside of the delivery pipes, between the compressor and cooling coils, sometimes great enough to restrict the flow of air, which, if nothing more, tends to increase the power demand.

With a knowledge of these conditions facing him, the engineer knows that it behooves him to keep his valves in shape and to clean the pipes occasionally by burning them out.

One of the most commonly employed and finest cleansing agents known fits itself admirably to the reduction of such work. This is soap and water. The most common trouble associated with its use in air compressors is that it is not used regularly and freely enough to do much good. Engineers who have heard of it seem to be afraid to use it, although common sense tells us that it can do no harm if properly applied and

is not likely to do any harm no matter how used. But in this, as in all other matters, "Safety First" is an excellent slogan, so let us abide by it. Do not pour soap and water into the compressor too fast and do not substitute caustic soda, sal soda or lye for soap.

For a compressor of about 1,000 cu.ft. of free air per min. capacity, make a scalding hot solution with three gallons of water and a bar of brown soap. Strain it to remove any pieces of soap that may not have dissolved. Pour a pint cup of this suds into the open breather pipe of the compressor every five seconds while it is running until all the suds are consumed.

Removing the Soapsuds

In the meantime the low-pressure drain at the bottom of the cooling coils should be wide open, the intermediate drain partly open and the high-pressure just cracked. These will carry off the suds while all foreign substance is still in suspension and will prevent the same quantity of water from passing through the various stages, which is correct, since the low stage has considerably more clearance volume than the others and will clear itself of more water per stroke owing to the greater delivery valve area. The other stages will not require so much water to cleanse them since their area is less and most of the deposits which form as the result of taking in impure air, stop in the low-pressure cylinder, which also takes the brunt of the lubrication. This is particularly true on the type of compressor that has the low-pressure cylinder between the intermediate and high.

The amount of foreign substance being removed can be estimated by observing the condition of the suds as they are drawn off at the drains. Results will have to be judged by an observation of the valves after removal.

Obviously, such a small amount of suds applied in the ordinary way such as with a scrub brush, would not remove the carbon and oil from a valve or other metal surface. However, the application of suds in the manner described is by no means ordinary. It is passed over the surfaces at a very high velocity and has a decidedly cutting effect. Pure water in itself would also serve and has been used successfully. We have evidence of what water will do when applied in the form of vapor moving at high velocity, when we examine the blades of a steam turbine that has been running on wet steam.

The Process Takes Time

The water-laden air moves at its highest rate of velocity as it passes through the openings in the valve cages and over the valves and is therefore most effective where it is needed most. A single application is sufficient to cleanse the valves and cages when they are comparatively dirty. However, a single application is seldom, if ever, sufficient to cleanse dirty air pipes, but to apply enough water at one time to clear these pipes would so devastate the compressor cylinders, pistons and rings of oil as to render the safety of operation doubtful. It is perfectly safe to repeat the process every day for a few days in order to clear the pipes, if in the opinion of the engineer, they need it. Ordinarily, once each week is sufficiently often to keep the entire system clean.

It often happens that the engineer spends more time cleaning up the valves and cages than is required to grind them once they are clean. It is also quite common to spend a considerable amount of time with their removal, since carbon sticks them fast in place. In addition to lengthening the periods between necessary overhauling of the valves, the time involved in their removal and cleaning will also be considerably reduced, particularly if the compressor is washed out only a few hours before it is shut down.

Although I have never had occasion to use soapsuds in a single-stage compressor, such as is used for supplying air for air machines, I feel that it would be helpful in these, since carbon and dirt accumulations on the valves are a source of trouble and the machine does not differ greatly from the first-stage cylinder of the high-pressure types.

The Preparation and Use of Lignite

Bulletin 255 of the United States Bureau of Mines, by O. P. Hood and W. W. Odell, discusses experimental work conducted between 1918 and 1925 in the carbonization of lignite for the purpose of preparing a better domestic fuel than raw lignite and recovering such byproducts as are available. The need for a "benefited" lignite for domestic fuel is generally recognized. The most promising processes carbonize the lignite and briquet the resulting char.

Equipment suitable for coking bituminous coal is distinctly unsuitable for handling lignite, the authors say.

Special equipment designed by the Bureau of Mines has yielded char, gas and tar with an aggregate heating value of 83.5 per cent of the heating value of the original lignite. The yields of byproducts—gas, tar, ammonia, oil and pitch—depend upon the nature of the lignite and the method of treatment, and in general are lower than from coking coal. The quality of the gas is lower, sometimes much lower, than from coal.

Carbonized lignite is excellent for producer-gas generators or on suitable grates for domestic or boiler furnaces. Its adaptability to pulverization should make it a satisfactory fuel for use in cement kilns.

For domestic use briquetted lignite char is comparable with anthracite both in heating value and in convenience in handling. While some smoke is evolved immediately after firing, the briquetted char burns much like anthracite and it can be stored in the same way.

These developments are of special interest to the Northwestern States, where the bulk of the lignite resources of the United States lies. This region has depended on the Great Lake coal trade, which, the authors say, has been stagnant for the last ten years. Carbonized lignite may change the fuel situation altogether in that part of the country.

Engineering Is a Profession and as such stands beside law and medicine. It is not a trade, though it is in contact with the trades. It is not a business, even though it has become a necessity to modern big businesses. Nor is it a science, though based on the exact sciences of physics, chemistry and mathematics, and in its practice the engineering method is essentially scientific. *It is concerned with utility, with the creation of services and things for public use, especially new kinds, better, more useful, or more economical than were available before. A most absorbing, clean, satisfying and unselfish game, the game of making nature work for man as man works for himself and his fellow-men, the finest and greatest game in the world.—Prof. Charles E. Lucke in Mechanical Engineering.*

Industrial Power-Plant Development*

By SAMUEL G. NEILER†

MANY engineers are versed thoroughly in such branches of power-plant design as combustion, furnace design, heating, refrigeration and the like, but by training or experience are not capable of visualizing and correlating all the items entering into the purely engineering field of industrial work. One may be a good designer of steam-boiler and generating plants, but when he looks out beyond the confines of the power house building, fails to see and appreciate that this power development is but a small part of the whole problem.

For example, electrical energy, steam, compressed air and water must be transmitted. Electricity must be supplied for light and power purposes, for ovens, laboratory heating units, welding, etc. Steam must be provided for heating buildings, for dry kilns, for process work and for heating water. Compressed air may be needed for the operation of drills, oil-burning furnaces, hoists, foundry molding machines and special foundry equipment. Water must be furnished for domestic use, process work, fire purposes and under high pressure for riveting and deforming steel, as well as refrigerated water for drinking purposes. There are dust-collecting systems for foundries, wood-working and other manufacturing industries; sand handling and its conditioning in the foundry; and in the manufacturing plant transportation methods for handling materials and the finished product, together with arrangements for storage and proper shipping facilities.

INCREASING economy in production is the keynote of modern industrial engineering. The power plant is but a small part of the whole problem. Requirements in the various manufacturing departments of the industry must be considered and the demands for service correlated, if maximum results are to be obtained. Economical production of power, utilization of byproducts, use of higher-speed machines, improved methods of handling and factory routing are some of the problems involved.

These are some of the things that must be considered by industrial engineers if they are to give their clients the full service to which they are entitled. It is only within the last few years that any concentrated effort has been made in the direction of analyzing plant conditions with the idea of increasing economy in production, not only in relation to the power plant, but in what is the most important end, the manufacturing departments of the industry.

Many advances have been made in the way of economical production of power, the utilization of byproducts, the advantages derived from higher-speed machines, improved methods of handling and factory routing of manufactured product, etc. A brief summary of this progress is included in the paper and certain definite rules laid down to determine whether a client should generate or purchase current. Almost invariably the modern industrial plant of from 2,500 to 10,000 kw. is complicated on account of demand for steam and industrial processes or by the necessity for the utilization of byproducts, and owing to these conditions the electric power becomes more or less of a byproduct and is developed in many cases at a cost with which the service supply company cannot compete.

It is clear that the problems found in connection with an industrial plant differ materially from those of the central station. The service-company plant location is selected arbitrarily where it is possible to obtain sufficient supply of condensing water, while the industrial plant has to be placed within a reasonable distance of the manufacturing buildings, frequently in a location to utilize readily waste fuel or gases, and a large water supply must be available or a spray pond must be built. In other words, the plant must be located where it is needed and treated accordingly.

Perhaps the greatest advance in the application of engineering to industrial plants has been accomplished by the increasing use of byproducts. For example, cement plants now generate sufficient steam from waste gases to operate their entire electrical equipment and provide for compressed-air requirements. No coal is used excepting at times of starting after a complete shutdown for yearly repairs, and the kilns use no more coal than before the waste-heat boilers were installed. One barrel of cement can be produced by one kilowatt or less of electrical energy delivered to the switchboard, or in other words, a 4,000-barrel plant requires 98,000 to 104,000 kw.-hr. daily, had from a previously wasted product, the use of which has reduced materially the cost of steam production and justifies a considerable expenditure for high-class economical equipment. The savings resulting show a decided reduction in the cost of the finished product.

In connection with a cement mill whose river-water supply contains from 54 to 69 grains of hardness, an interesting boiler-feed situation is reviewed, which was relieved by the installation of an evaporator plant connected up in such a manner as to utilize all safety-valve blow as well as excess steam at other times. The condensation from the evaporators was stored to be used throughout the 16-hour period of operation or as might be required. By the entire elimination of blowdown, it was possible to obtain an additional 15,000 lb. of steam per hour from the boiler plant.

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†Senior member of the firm of Neiler, Rich & Co., consulting engineers, Chicago.

Experience in these plants led to the conclusion that the utilization of waste heat in cement plants had reached a point of perfection where any marked improvement was not to be anticipated in the immediate future excepting in boiler, and possibly setting, design. In the early installations it was believed that a high velocity of the gases through the boiler would produce maximum output, but it now appears that there is a critical point beyond which any greater flow of gases does not increase perceptibly the evaporation. In consequence, should kiln output increase, advantage must be taken by providing additional boiler capacity, or if this is not required, the excess gas may be removed by an arrangement recently proposed whereby gases may be drawn from the main flue or breeching by a type of induced-draft fan in connection with a stream-line stack, the stack damper being governed manually and the fan speed by gas pressure variation in the main flue or by steam pressure.

Tube Abrasion Affected by Volume of Gases

Another limiting feature having a direct bearing on boiler life and safety is the abrasion of the tubes, which increases to a marked degree as the volume of gases handled becomes greater. This same trouble is experienced with the induced-draft fan blades. A suggestion to overcome the erosion of blades and tubing is to place an eliminator between the kiln and the boiler and

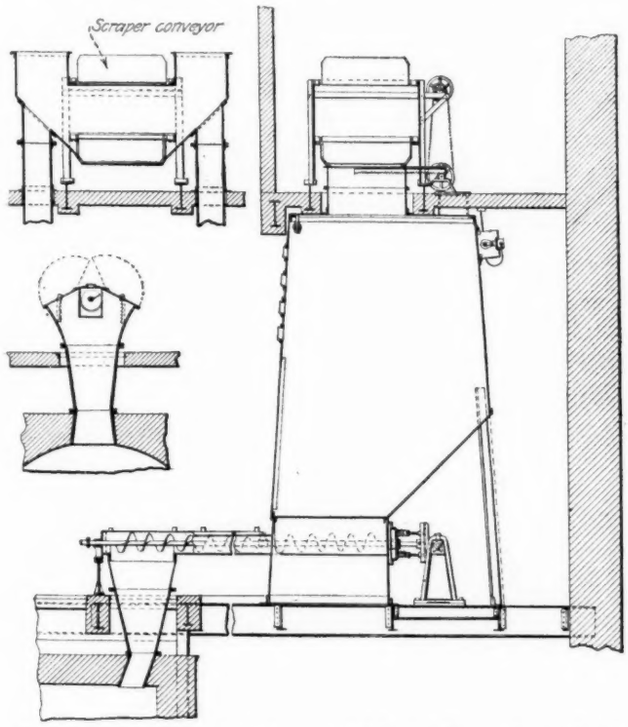

Fig. 1—Arrangement for variable feeding of sawdust from bin to furnace

to slow down the velocity with the idea of reducing the abrasion in the boilers and fans.

A decided advance has been made in collecting the cement dust previously discharged to the atmosphere, by a number of devices, such as cyclone heads placed over each stack, the Cottrell electrical system and a recent development on the order of the eliminator used in air washers.

Some surprising results have been obtained from burning wood waste of great varieties, from sawdust containing as high as 15 per cent moisture to that from kiln-dried lumber, the former being mostly pine, spruce and fir, and the latter oak, birch and maple, with another distinct class such as planer chips from Georgia pine and the long ash wood shavings from turning lathes. The handling of blocks and edgings is not diffi-

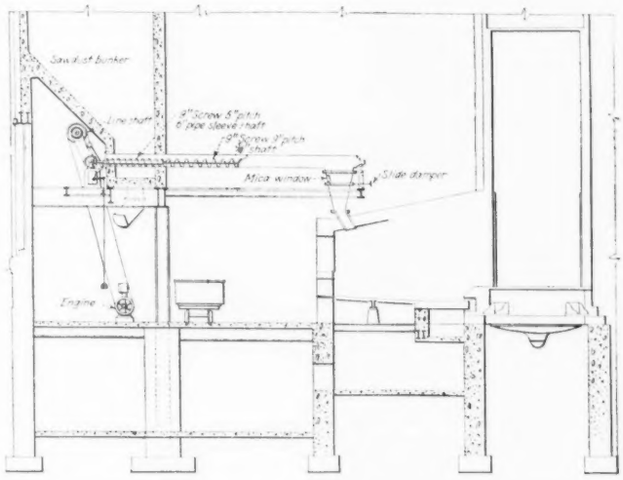

Fig. 2—Feeding sawdust through conveyor with pipe sleeve on shaft to prevent clogging

cult, as this material is hogged before being passed to the storage bins. The old type of knife hog has been replaced largely by the hammer hog, which reduces the material to a dry pulp. This type of machine handles refuse of almost any character, such as straw, pasteboard boxes, excelsior or paper, accumulating about the plant.

Economical Burning of Wood Refuse

Development in the economical burning of wood refuse has been marked, owing principally to the close analysis being given to the results obtained from different types of furnaces. In general, it can be said that the experimental stage has passed and furnace design has been narrowed to within certain definite lines for the different classes of fuel. The older method, and one still used to a considerable extent, of delivering the fuel through pipes brought directly from collector heads to the furnace, is not considered advanced practice, owing to an excess of air being passed to the furnace with the fuel, the lack of uniform feeding, an absence of feed control, and above all, uneconomical burning without assurance of smokeless combustion. Where the steam demands are in excess of the steam that can be produced from this byproduct material, the fuel must be burned with the highest possible efficiency commensurate with minimum initial installation costs.

Figures that have been made available on the boiler performance with these fuels are as follows: With sawdust from kiln-dried wood, such as oak, birch or maple, containing 7.57 per cent moisture, an evaporation of 4.33 lb. of water per pound of fuel has been obtained. The greater portion of this fuel is burned in suspension in a Dutch oven furnace, boilers being of the horizontal water-tube type, vertically baffled and operating at approximately 150 per cent of rating.

Fig. 1 shows a design of sawdust and storage bin

with a scraper conveyor above and a screw conveyor below, operated by a friction roller working on a disk. This driving roller is operated directly from a continuous shaft and the speed of the screw varied by shifting the friction bearing either closer to the center or toward the outside of the disk. In operation, this particular screw was adjusted to deliver 3.27 lb. of sawdust per revolution.

With planer chips and hogged material of oak, ash and birch containing approximately 6 per cent moisture, an evaporation of 4 lb. of water per pound of wood waste was obtained. This material was burned directly on a grate with ⅜-in. openings. The boilers are of the vertical water-tube type, each containing 4,000 sq.ft. of heating surface and operating at nearly 200 per cent of rating. The installation supplies 70 per cent more power with only 20 per cent additional fuel, as compared to the plant it replaced.

Fig. 2 shows in diagram the relative location of the sawdust bunker and the screw conveyor, and attention is called to the pipe sleeve inserted on that portion of the 9-in. screw, within the bin. Beyond the bin the same screw with the same pitch is fitted with a ⅜-in. shaft. This arrangement prevents clogging of the feeder screw.

Features of New Plants Under Construction

A new plant is being built that will contain four vertical boilers, each of 5,080 sq.ft. of heating surface, fed separately and provided with Dutch ovens with ventilated side walls, the air being introduced through openings about midway between the top of the furnace doors and the flat arch. It is expected that the boilers will operate at 200 per cent of rating and burning fuel containing 6 per cent moisture, will evaporate at least 4.5 lb. of water per pound of waste. About 90 lb. of sawdust per square foot of grate will be burned. Fig. 3 shows the type of installation described, the furnace being equipped with ventilated side walls and openings at the front through which the preheated air is introduced.

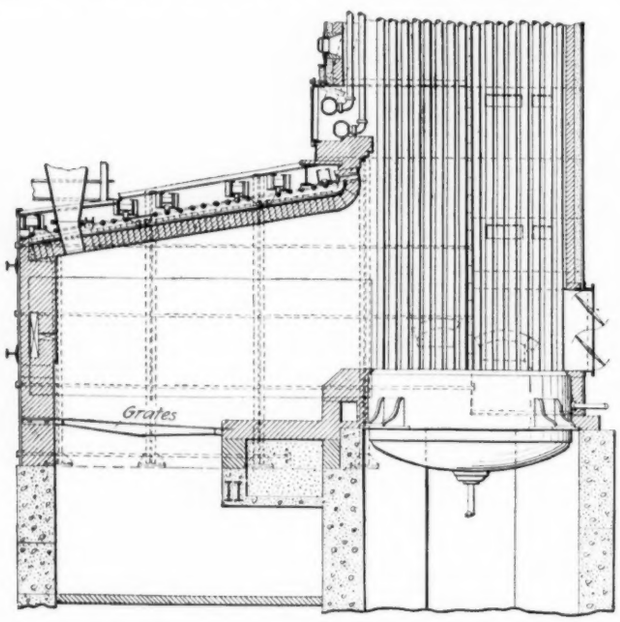

Fig. 3—Late development in sawdust burning furnace, equipped with ventilated side walls

Should the demand be greater than can be produced from waste wood, it is important that the boiler furnace be so built as to have part of the plant equipped for burning coal, or a combination of coal and wood, and the equipment be so arranged that a change or a combination of fuel can be taken care of. The underfeed stoker is well adapted for an arrangement of this kind, and Fig. 4 shows such an installation now in the course of erection.

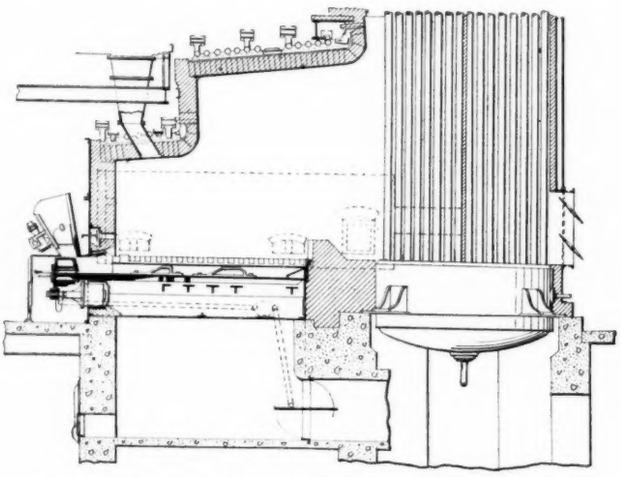

Fig. 4—Sawdust-burning furnace equipped with underfeed stoker

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Selection of Circuit Breakers for Low-Voltage Applications

By BURT S. BURKE
Switchboard Engineer, Westinghouse Electric & Manufacturing Company

A CIRCUIT BREAKER, whether it be of the air-break or oil-break type, has a certain duty to perform, which consists primarily of opening a circuit. That is, while a circuit breaker has to carry the current flowing in the circuit and be designed with sufficient insulation for the application to which it is put, its primary function is that of opening a circuit to clear a fault or to disconnect some part of a system. As a matter of fact, the ability of a breaker to interrupt a circuit is the method by which a large number of breakers, especially oil circuit breakers, are classified.

Air circuit breakers are most generally used on direct-current circuits. Of course this, on the one hand, is unavoidable, since oil circuit breakers are not suitable for direct-current service except for special applications. On the other hand, there is no reason why air circuit breakers should not be used on low-voltage alternating-current systems except as limitations other than the purely electrical differences between the two types of systems affect the application. Oil circuit breakers have become initimately associated with alternating-current systems. This, however, is due to their not being as well suited for direct-current as for alternating-current operation, rather than the fact that they were first developed for alternating-current service. Another reason for the use of oil circuit breakers on alternating-current systems is that such systems are often so interconnected that an enormous amount of power may be fed into a fault. This calls for a breaker with a large interrupting ability. Extensive tests have been run on oil circuit breakers, and they are definitely classified with regard to interrupting ability, hence it is a comparatively simple matter to choose a breaker large enough for any particular application. Air circuit breakers have been closely associated with direct-current systems and have not been subjected to the extensive tests that the oil circuit breakers have, although some important tests have been made. With the interconnection of direct-current systems that is being done in many large cities for supplying power for railways, complete data on air breakers become more important and undoubtedly will soon be available. In fact, several of the larger operating companies are co-operating with manufacturing companies in making such tests.

THE dividing line between the cases in which an air-break circuit breaker should be used, and those in which an oil circuit breaker should be used, if such a line exists, is very elastic and subject to numerous qualifications. Different individuals have had varying experiences with circuit breakers and have drawn their conclusions from their own experiences. Since in some cases these experiences have been favorable to one type of breaker and in other cases to the other, it is only natural that different opinions should result. However, there are certain definite considerations that affect the application of these two types of circuit breakers and this article outlines these conditions.

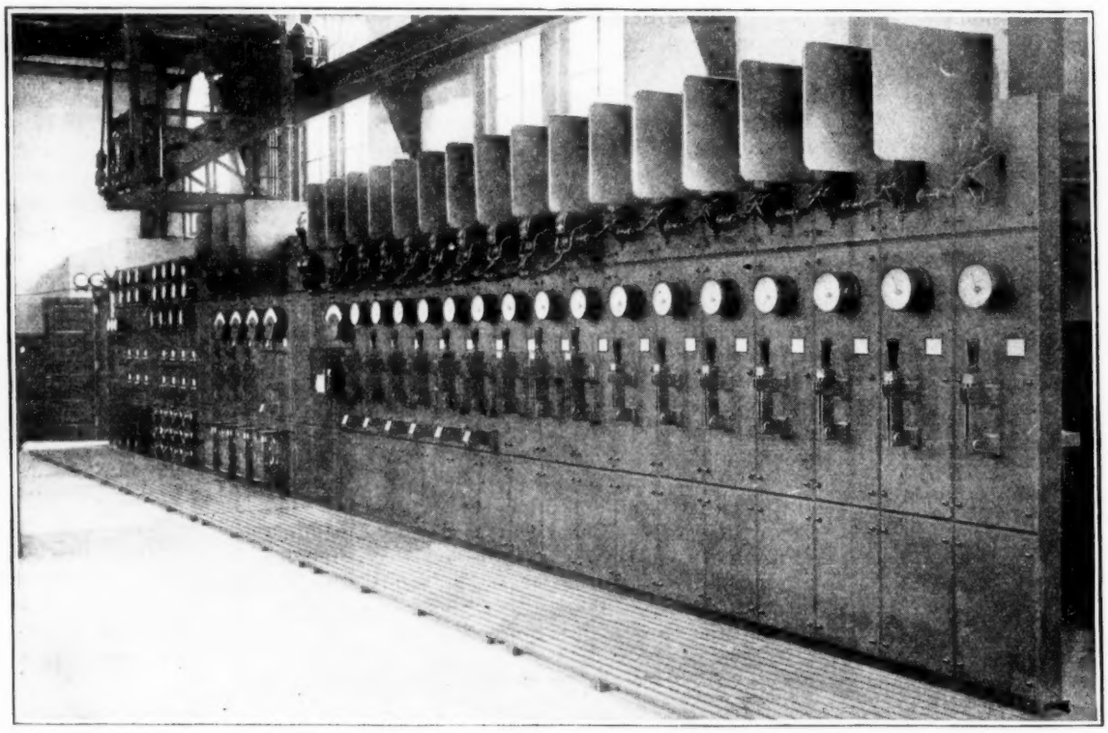
As a general rule we may say that the air circuit breaker may be employed for all direct-current circuits and low-voltage alternating-current circuits. Such a statement may seem rather broad, especially with regard to the application to alternating-current circuits, but the design of modern air circuit breakers is such that they are capable of handling the short-circuit currents to be expected even on the larger low-voltage network. The oil circuit breaker, on the other hand, is applicable to all alternating-current circuits, of either low or high voltage, it being only necessary to choose the proper size breaker for the application. It is not applicable to direct-current circuits except for special cases, which will be discussed later, owing to the action of the direct-current arc in carbonizing the oil. Oscillograms have been obtained showing an air circuit breaker successfully interrupting 40,000 amperes direct current on a 600-volt circuit. Thus, as in all matters, there are exceptions and special applications which prevent the formulation of any general rule that may be unhesitatingly followed in choosing circuit breakers. It is these exceptions that make breaker applications a matter deserving careful consideration before a decision is made. If this were done in each instance, fewer misapplications would be made, purchasers would be better satisfied, and manufacturers would save themselves considerable difficulty that is now experienced in servicing such misapplications.

Perhaps the most obvious places where an air circuit breaker cannot be used are where there is a possibility of explosive mixtures in the atmosphere. It is readily seen that in such places the arc from a circuit interrupted in air would cause an explosion. These locations include flour mills, grain elevators, powder mills and similar plants. Such applications require oil circuit breakers for both direct-current and alternating-current circuits. In these places it is common practice to locate the switching devices in dustproof rooms at load centers in the plant. Providing a dustproof room greatly reduces the danger of explosion. Should any explosion occur, it is confined to the switchroom and is not as likely to cause a general fire as if the switches were out where such a disturbance could readily communicate to the rest of the building. By keeping as much dust as possible away from the circuit breakers, maintenance

is greatly reduced, thus resulting in more efficient operation as well as a saving in upkeep.

Another special problem is encountered in cement mills, rock-crushing plants and similar industries where very dusty conditions prevail. The dust in these plants is not explosive, so that the use of an air circuit breaker is not prohibited. However, this dust collects on circuit breakers' contacts and on knife switches to such an extent that unless constant care is taken to keep the contact surface bright and clean, the current-carrying capacity of the switches is impaired. Since heavy maintenance is required to keep exposed switch contacts in good condition, it is general practice in such applications to use a switch of double the rating of the circuit on which it is to be used. That is, a 100-ampere circuit would call for a 200-ampere switch and so on. Here again, is good application for an oil circuit breaker. This type of unit with its contacts immersed in oil eliminates the trouble experienced with air circuit breaker contacts, thus reducing maintenance costs and allowing the operator to use a breaker of the same rating as the circuit instead of having to have a margin to prevent the contacts from heating. The disconnecting switches for such an installation, however, must still be selected, leaving ample margin for the current-carrying parts, and in both cases extra insulation must be provided to offset the effect of the dust that accumulates on the insulators.

Perhaps the most involved problem of circuit-breaker application is encountered in the case of low-voltage industrial systems carrying heavy alternating currents. Owing to the skin effect in the conductors, it is necessary to divide each pole of the circuit breaker into several parallel paths. With air circuit breakers this is done by using several brushes in parallel on a common contact block or, as in some of the larger sizes, two parallel contact blocks per pole are used, each having several brushes in parallel. This method is used in some oil breakers having a 3,000-ampere capacity and above at 60 cycles. Larger breakers than this are of the type known as the multi-multipole breakers. That is, each pole of the breaker consists of a two-, three- or four-pole breaker whose poles are paralleled so as to form, in effect, a single pole. Owing to the self-inductance of the paralleled conductors of each phase as well as the mutual inductance of adjacent phases, the currents do not divide equally in the brushes of the breakers. This action is difficult to control, although it may be regulated in some cases by balancing the resistances of the parallel paths. When this is not possible, the condition may be corrected by introducing a small amount of reactance in the conductors carrying too much current.



Typical air-break circuit-breaker installation

If this is necessary, it is carried out somewhat more easily in the oil breaker since each brush has its individual stud coming out of the breaker, while in the air breaker several brushes are paralleled on one contact block. The reactance may be inserted in the lead in the form of several iron laminations around the conductor, or a current transformer with its secondary short-circuited may be used.

However, even if every precaution is taken, it is practically impossible to make the currents divide equally in the various paths of each phase, and when an unbalance, such as previously referred to, occurs, local heating results. In the oil circuit breaker the contacts are immersed in oil which performs two important functions. First, it acts as a cooling medium and tends to prevent the temperature of the contacts from rising. Secondly, the oil excludes all air, so that the copper contacts oxidize slowly. On air circuit breakers the contacts are exposed to dust and dirt. Since most of

the heat is carried away from the current-carrying parts by convection, the copper parts should be in intimate contact with the cooling air, which is not possible when they are coated with dust. As a result, any local heating due to unbalanced currents in the various conductors is not taken care of as effectively as with oil breakers. Consequently, the temperature of the affected part rises, oxidizing the contact and increasing its resistance so that further heating results. Therefore, for heavy alternating-current service the air circuit breaker requires more attention than the oil breaker to give the same satisfactory operation.

When the Air Circuit Breaker Has an Advantage Over the Oil Breaker

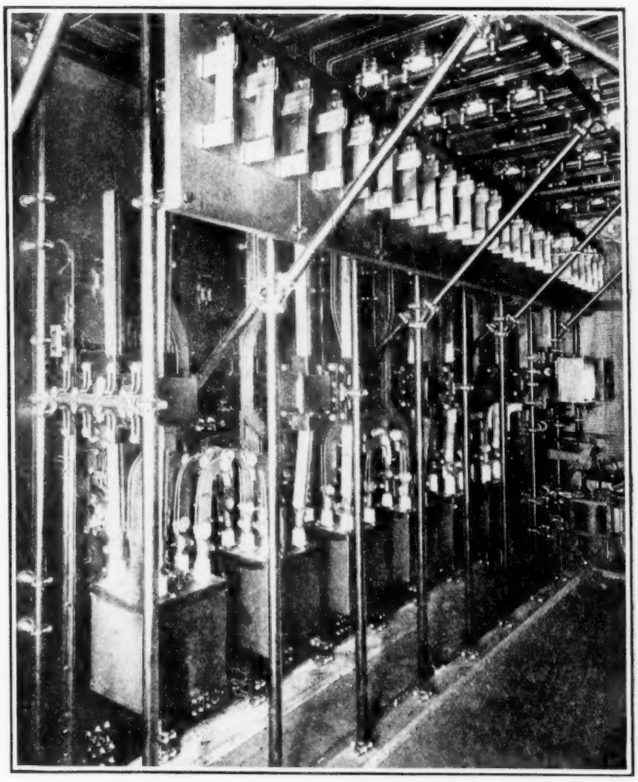
Where space requirements are the principal factors to be considered, the air circuit breaker has an advantage over the oil breaker. The former is a single unit and can be mounted on a slate panel which requires small space compared to that needed for an oil circuit breaker of the same duty. However, the fact that the air breaker is a single unit is not always an advantage as in the case of interlaced busbars. When 60-cycle circuits carry more than 6,000 or 8,000 amperes, it is general practice to interlace the busbars to reduce the inductive effect of the current. In a busbar of this type, parallel conductors of each phase, instead of being adjacent to each other, are separated by conductors of the other phases. With this arrangement it is much easier to locate the units making up the oil breaker beneath the various busbars than it would be to carry the connections across the rest of the busbars making up the interlaced structure to a single breaker unit such as the air circuit breaker.

From the foregoing it is evident that the type of breaker to be used depends largely upon each application, and considering the cost of this type of equipment a thorough investigation of both units should be made, taking into consideration the special requirements of the service the breaker will have to perform. From this survey it can be determined whether space required, first cost or cost of maintenance will be the determining factor and the choice of breaker can be made accordingly.

Other Things That Should Be Considered Before Choosing Type of Breaker

In addition to the factors already considered, there are certain other qualifications dealing with the economic phase of the questions that should be carefully considered before one type of breaker or the other is chosen. This phase may be divided, as in the case of practically all commodities, into first cost and the cost of maintenance. The first cost varies greatly with different manufacturers, and a general statement covering the first costs of the two types of breakers in question cannot readily be made. Furthermore, although the cost of air circuit breakers varies almost directly with their current ratings, that of oil breakers varies with their current rating and the interrupting capacity. Maintenance, however, is a more tangible factor and can be treated somewhat more definitely.

In any application the question of maintenance is an important one and should always receive due consideration. With an oil circuit breaker, since the current-carrying parts are immersed in oil, the maintenance is a rather constant factor and consists of a periodical inspection of the breaker and an inspection after each time that it opens a severe overload or a short-circuit. The periodical inspection of the breaker, in order to determine the conditions of contacts and oil, for normal service, should be made at intervals of approximately three months. This inspection will determine whether all the parts inclosed in the tank are in good condition, and those which are not should be either repaired or replaced. The number of inspections after short-circuits will vary with the class of service, since this factor is directly dependent upon the number of short-circuits which are experienced. While it is not as easy to inspect the parts of an oil circuit breaker as those of a carbon circuit breaker, such inspection is necessary only at infrequent intervals except in the case of short-circuit.



Typical low-voltage oil circuit-breaker installation

The problem of maintaining the air circuit breaker is one that varies greatly, depending upon the conditions under which it operates. First, consider the case of an air circuit breaker carrying such a current that its temperature is well within the limit of 70 deg. C., set by the N.E.M.A., and located in a well ventilated room free from dust, dirt or corrosive gases. In this case its contacts suffer but little from oxidization, and the wiping action, when closing, will be sufficient to keep them clean. Thus, the only attention this unit will need will be after opening short-circuit, and occasional inspection of the arcing contacts and mechanism to ascertain whether they are in first-class condition. Since this may be done easily, all parts of the breaker being clearly visible, the maintenance factor may be considered negligible.

Next, consider an air circuit breaker in a room free from dust, dirt or corrosive gases except that the ambient temperature of the room is such that its temperature reaches the limit of 70 deg. C. set by the

N.E.M.A. At this temperature oxidization of the copper parts of the breaker will occur at a rather rapid rate, therefore, necessitating their frequent cleaning so that they will carry their rated load without overheating. It is evident that the factor of maintenance is quite an appreciable one in this case.

Worse than these two applications, is that of circuit breakers located in a room exposed to dust, dirt or corrosive gases or the combination of the three. In this case the corrosion of the current parts takes place at such a rate that close inspection and attendance are necessary. Under these conditions the maintenance factor becomes one of prime importance. The oil circuit breaker may be used for a similar application with only a small increase in maintenance above the routine inspection of contacts, oil and insulators necessary in all installations.

While the inspection of air circuit breakers is a more simple matter than that of oil circuit breakers, since all the parts of the former are easily accessible, in many cases this advantage is offset by the frequency with which these inspections must be carried on as compared to those of the latter. Furthermore, in most cases one of the contacts of the air breaker is live and a certain amount of care is necessary in cleaning this contact. The oil circuit breaker, on the other hand, is usually provided with disconnecting switches for isolating it, so that the breaker is entirely dead when these switches are open.

The oil circuit breaker also is generally located at a convenient height above the floor, so that after the tanks are once removed, the contacts are easily available to work on, where in the case of a carbon circuit breaker it is usually located at the top of the panels so that it is necessary for the inspector or maintenance man to use a ladder or some other similar means to work on it.

Safety Should Be Considered

Another point worthy of consideration, especially since safety-first practices play a prominent part in the factories of today, is the safety feature of the electrical equipment. The oil circuit breaker is inherently a safer piece of apparatus than the air circuit breaker owing to the fact that the arc is entirely confined. Also the contacts and main current-carrying parts of the oil breaker are entirely inclosed, and the terminals that are outside the tank are usually heavily taped. While these features do not make the oil breaker an entirely mistake-proof piece of apparatus, the inaccessibility of the current-carrying parts provides a form of protection that is not possible with the air circuit breaker.

The oil circuit breaker is designed to be mounted on the rear of the panel or remote from it and is controlled either manually or electrically from the front of the panel. The air circuit breaker, on the other hand, has in general been a front-of-board piece of apparatus and does not afford the protection obtained by having the circuit breaker at the rear. With the advent of steel switchboards air circuit breakers are being designed for back-of-board mounting with an operating handle on the front of the panel. This type of construction allows having an entirely dead front board and still using air circuit breakers where desired.

From this discussion it may be seen that the question of whether to use an oil breaker or a carbon breaker often becomes quite involved. This article has been prepared with the purpose of outlining some of the fundamental considerations affecting this question. It is quite evident that to cover all the conditions affecting each application is an impossibility in an article of this sort, since each application that departs from standard practice presents its own peculiarities. These can be successfully overcome only when the purchaser lends his operating experience to the manufacturer to combine with his design experience. When such a policy is followed, it will inevitably result in fewer misapplications of breakers and give the operator more reliable service and a corresponding reduction in cost of operation.

Simple Tests for Impurities in Battery Electrolyte

By Anthony J. Christopher

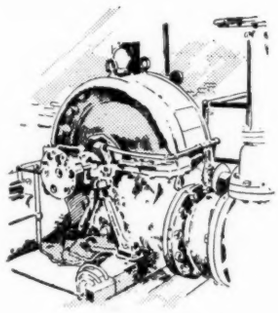
Storage battery equipment of power plants is usually quite expensive and has a comparatively short life. While a slight abuse in charging or discharging is sometimes unavoidable, the worst enemy of a battery is an impure electrolyte. For this reason only pure distilled water and battery sulphuric acid should be used. Water from a faucet may contain traces of minerals. Iron, platinum, copper, nitrates and chlorine in the solution are harmful to the battery in a greater degree than any other impurities, and doubtful water, acid or electrolyte should be tested to determine if it contains any trace of these substances.

Iron is one of the chief enemies of the storage battery. To make a test for this metal, neutralize a small amount of the electrolyte with ammonia. Then add an equal amount of hydrogen peroxide and boil. After thus heated, mix with ammonia or caustic potash until the liquid becomes alkaline. The forming of a brownish red precipitate shows the presence of iron in the electrolyte.

The slightest trace of platinum in the storage-battery solution causes local action, and it is evidenced by gassing of the battery when on open circuit.

Mercury in itself does no harm in a battery, but it often combines with other metals to cause local action, and if in sufficient quantity, it may amalgamate the plates. To a sample of the electrolyte add lime water. The formation of a black precipitate indicates mercury. Another test for this metal is to add a solution of potassium iodine to the electrolyte. If it contains mercury, an olive-green precipitate will be seen. To a sample of electrolyte add ammonia slowly, and if there is copper in the solution a bluish white precipitate will be obtained.

To test for nitrates, add ten grains of strong ferrous sulphate solution to a test tube three-quarters full of electrolyte. Next carefully pour a little pure sulphuric acid down the side of the tube. If a brown layer forms between the electrolyte and the concentrated acid, there is nitric acid in the liquid under test. A white precipitate indicates chlorine, when a few drops of silver nitrate solution (about 20 grains of silver nitrate dissolved in 1,000 c.c. of water) is added to a small quantity of the electrolyte. To insure that some other impurity in the electrolyte will not interfere with the correct reaction, it will be well to add a few drops of nitric acid to the electrolyte before adding the silver nitrate. The manufacturers of batteries maintain chemical laboratories and are always ready to advise the user of their equipment on the condition of the electrolyte or water being used.



Slow Movies in the Power Plant

By C. L. FORBES

Southern California Edison Company uses photography to reveal equipment deterioration and obtains complete record of plant apparatus through photographs taken at stated intervals

PHOTOGRAPHY can be made to play an important part in power-plant operation, for one of the most convincing yet brief methods of representing the physical condition of equipment in the power station is by means of photographs.

For example, consider the condition of the refractories in a boiler furnace wall. If a set of pictures is available showing progressive deterioration over considerable periods of time, a brief report may be presented to an executive, clearly showing the nature of the trouble and suggesting the character and location of necessary repair work. The permanent record shows beyond argument what has occurred, and the errors often arising from the inability to form word pictures that adequately visualize the state of affairs are avoided.

The application of photography is probably more practical in a large station than in a small one, as in the larger station the executive is less likely to have time to look after such details as power plant maintenance.

A photographic record of the condition of the equipment, taken at intervals covering considerable periods of operation, serves as a source of information to the manufacturer regarding the performance of his product and permits him to make the necessary change in his product to permit it to overcome the difficulties arising during the course of operation. This idea is especially applicable to a plant at a considerable distance from that of the manufacturer.

Slow movies is by no means a mere theoretical idea, for the plan is being used in the Long Beach steam plant of the Southern California Edison Co. Each time the boiler is taken out of service, six pictures are made of the furnace walls, giving a complete record of the condition of the refractory surfaces at the date the pictures were taken. Since oil and natural gas are the fuels burned at this plant, the number of hours the boiler has operated on each fuel is listed on the picture, with the date, boiler number and index number of that section of the furnace wall that the photograph represents.

Examples of such pictures are shown in the illustrations. When using the ordinary folding pocket camera, such pictures usually require about 15 minutes' exposure with stop 32. Two 200-watt nitrogen lamps equipped with reflectors provide all the light necessary. These photographic conditions have to be altered occasionally to conform to the degree of darkness of the refractory surface.

The pictures are taken by a member of the efficiency department, each boiler requiring about 1 hour and 45 minutes for the six exposures. The photographs are postcard size. Flashlight pictures have not been found satisfactory for bringing out the details in this work. The furnace pictures, Figs. 1, 3 and 5 were taken Nov. 6, 1926, to illustrate the condition of the refractories of a 15,000-sq.ft. boiler in this plant. The boiler is practically new, having operated 253 hours on gas and 1,107 hours on oil up to the time these photographs were taken. Those in Figs. 2, 4 and 6 show the condition of the furnace walls of the same boiler a little over a month and a half later. Between these two dates the boiler had operated 26 hours on gas and 746 hours on oil.

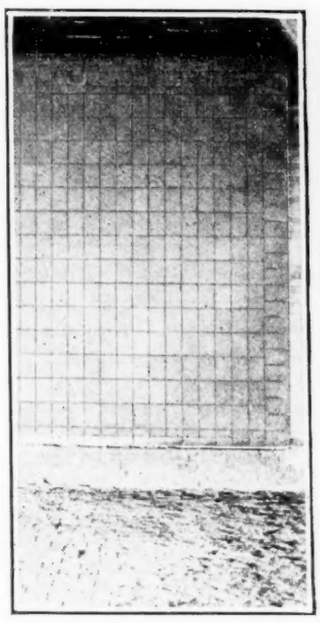


Fig. 1—View of water wall before boiler went into service

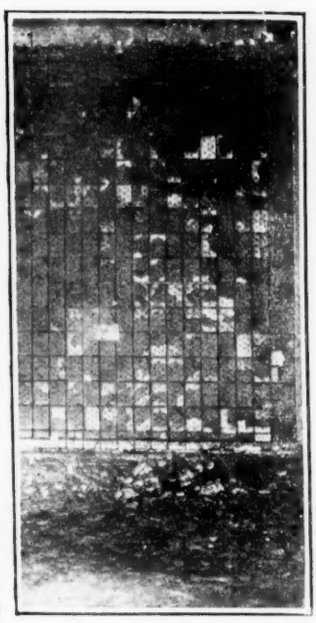


Fig. 2—Spawling shown after one month's operation

Because of the satisfactory results obtained in the boiler room, the work has been extended to include other equipment.

By making use of the

portrait attachment, pictures have been taken of the main turbine rotor showing the condition of the blading at the time the unit was inspected. Similarly, photographs have been taken of the scale formation on the evaporator coils and also of the seal rings on the circulating pumps, these being important places of wear.

The value of the results obtained from these pictures may be shown by the fact that the steam generation department of the Southern California Edison Co. has considered this phase of photography of sufficient importance to incorporate it as a definite part of its mechanical and electrical maintenance schedules.

A series of photographs are of especial value when a new method of application or of operation is being tried out. It is impossible for one to carry a comprehensive mental picture of the progressive deterioration of, say, a refractory wall. At best the impression can only be general. With the photographic method each time the fire is pulled one or more photographs may be taken, and when placed in sequence, they will reveal when and where any trouble starts. In fact it is a most logical method whereby the comparative results obtained with different makes of refractories can be accurately ascertained. The pictures eliminate any room for argument.

It might be thought that the camera, lights, etc., are so costly as to prevent the adoption of the method in the smaller plants. In fact a low-priced camera will give satisfactory results and the lamps need not be expensive reflectors, for good ones can be made from bright tin sheets or tin-foil-coated pasteboard.

It will require no great amount of thought for an engineer to discover scores of uses for progressive photography.

The operating engineer has been slow to adopt apparatus not strictly mechanical, often to his disadvantage. There is no reason why the camera should not be called into play in mechanical engineering as in the other professions.

It is not necessary for the engineer to be an expert of photography, for the pictures are all time exposures and a doubling of the correct exposure time will not destroy the picture, and in a short time one can gain the ability to gage the proper exposure.

Executives could do much toward keeping in touch with the power plant by insisting upon the taking of photographs periodically.

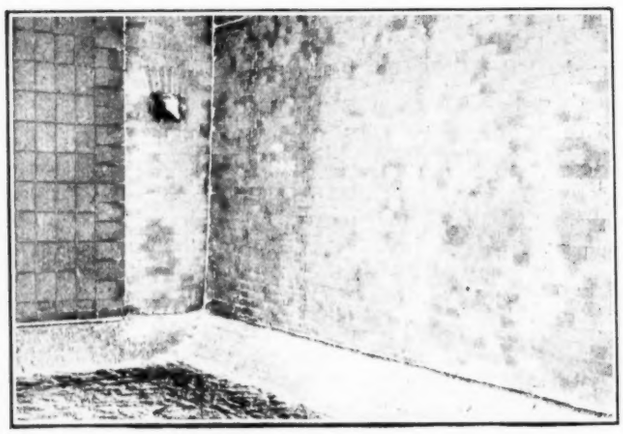


Fig. 3—Original condition of the bridge wall

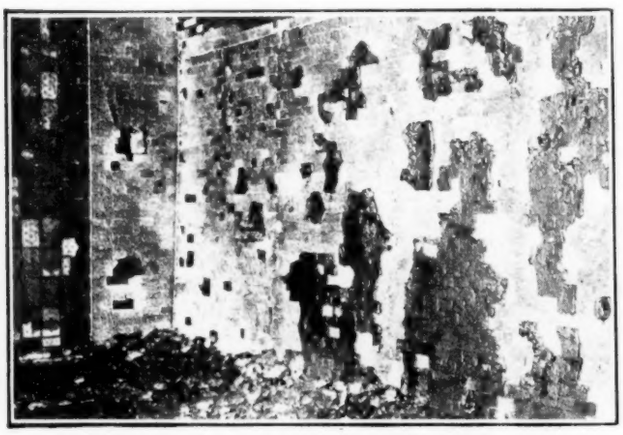


Fig. 4—Damage shown in the bridge wall

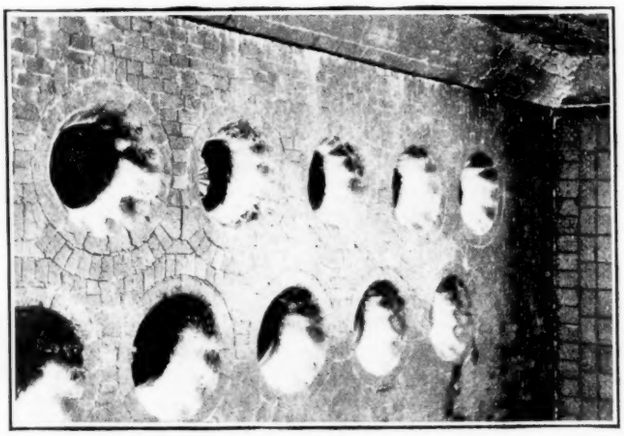


Fig. 5—View of oil burner openings

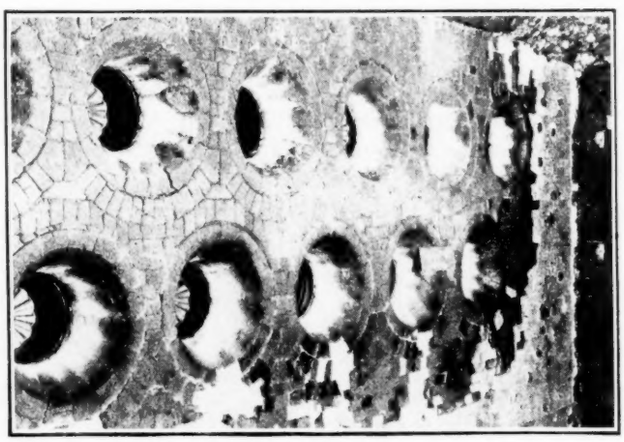


Fig. 6—Burner wall after one month

IN COMPOUNDED OILS there will be found more or less fatty acids. These are not active in attacking metal and so are harmless in this respect. They, however, do increase the tendency to form emulsions if water is present. In addition, in the presence of a small amount of moisture they may cause corrosion. Greases, such as used to lubricate bearings, will almost always show some degree of acidity. No corrosion will occur unless moisture has been present. It should be understood that fatty acids never are as dangerous in this respect as mineral acids.

Calumet Boiler Generates 300,000 Lb. of Steam per Hour

AN INTERESTING application of pulverized fuel for central station use has been made in the Calumet Station of the Commonwealth Edison Company. Viewing this installation was one of the features of the recent Midwest Power Conference in Chicago, and at that time information additional to that given in the review number of *Power* of Jan. 4, was made available on the construction and general arrangement of the unit.

As indicated in Fig. 1, the Calumet boiler consists of a B. & W. unit of the horizontal cross-drum type but of special design, having a heating surface of 5,805 sq.ft. It was built for a working pressure of 375 lb. The boiler proper is 40 sections wide, the sections being 7-high and built of 3½-in. tubes 17 ft. long. The cross-drum is 48 in. in diameter.

The boiler is equipped with a steaming type econo-

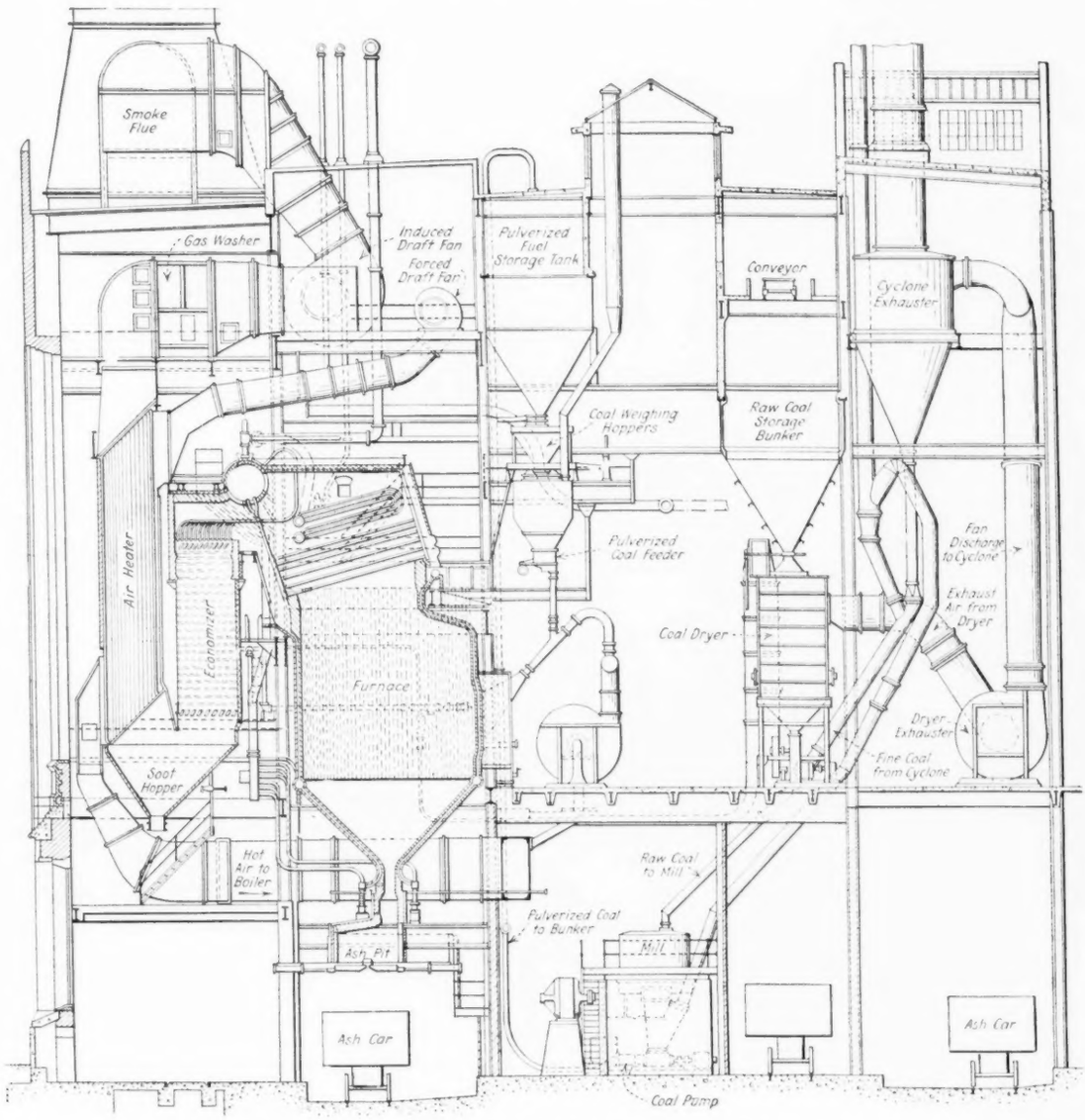


Fig. 1—Section through Calumet pulverized-fuel boiler unit

mizer of the counterflow, loop type, modified from the earlier forms of this general design of economizer only so far as the method of connecting it to the boiler is concerned, to take care of the steaming. It contains 8,850 sq.ft. of surface. A superheater of convection type has 5,017 sq.ft. of surface and a tubular air heater of the single-pass counterflow design with inclined tube

sheets has 41,700 sq.ft. of external heating surface and 37,650 sq.ft. of internal heating surface.

In the furnace a volume of 11,200 cu.ft. has been provided. It is completely water cooled and the exposed surface of the Bailey blocks aggregates 3,242 sq.ft. Summarizing, the heating surfaces of the component parts of the unit are as follows:

Boiler surface, sq.ft.	5,805
Furnace heating surface, sq.ft.	3,242
Economizer surface, sq.ft.	8,850
Total water surface, sq.ft.	17,897
Air heater surface, sq.ft.	41,700

Coal is fed to an air-heated drier, then to a 70-in. ball mill from which it is discharged to a small pulverized fuel bin. From the bin the coal descends by gravity through a weighing hopper to the Bailey feeders and then to the burners, of which there are eight to the boiler, of the Calumet type, formerly known as the Bailey intertube burners. The fuel used is Kincaid coal from central Illinois, a typical analysis of which follows: C, 61.25 per cent; H_2, 4.48; O_2 10.62; N_2, 1.00; S, 4.42 per cent. Ash, 18.23. Moisture, 14.5 per cent, dried to 10.5 per cent. B.t.u. per pound, dry, 11,800. Fusing point of ash, 1,850 deg. F.

Details of the burner and of the wall and floor construction of the furnace appear in Figs. 2 and 3.

This combination of boiler, superheater, steaming economizer, air heater and water-cooled furnace was

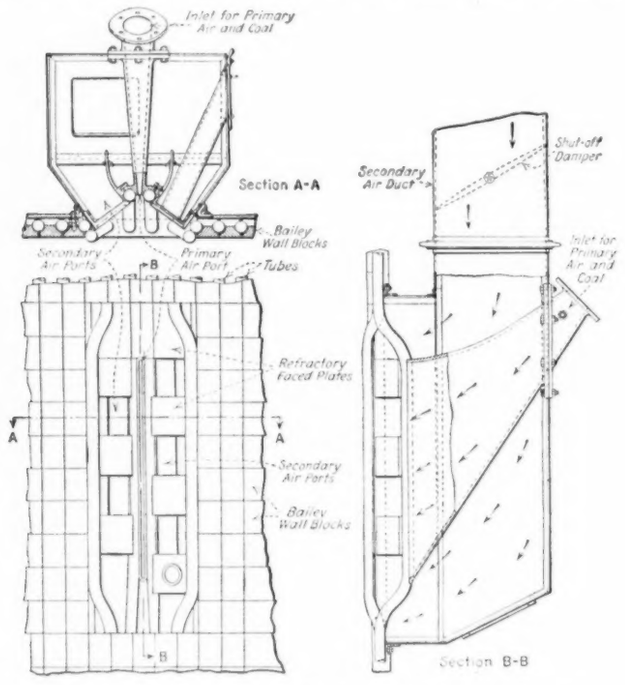


Fig. 2—Calumet type of pulverized coal burner

considered first in April, 1925. The contract for the unit as installed was placed in January, 1926, and the unit was placed in regular service on Nov. 15, 1926. The principal parts of interest observed so far are the flexibility and the great steaming capacity of the installation. During a recent trial an evaporation rate of 300,000 lb. per hour was reached. At this rate 30,000 B.t.u. were released per cubic foot of furnace volume per hour, and the indications were that these figures represent by no means the limits of this boiler unit. At this particular time the limiting factors are the capacities of the fans and of the boiler-feed pump against the excess friction head developed by the rate of feed. It was not possible to hold the boiler long enough under the conditions cited to determine whether the slag problem will become formidable or not. An indication of what the foregoing rate of output means in the way of evaporation per square foot of surface is shown in the accompanying table.

Inasmuch as but a small portion of the economizer

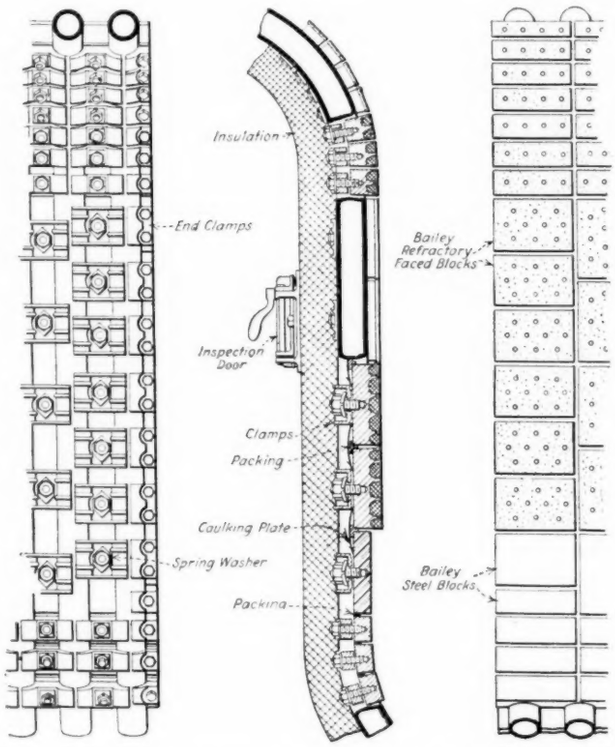


Fig. 3—Typical examples of furnace wall and floor construction

is making steam, the rates of evaporation, considered on the ordinary basis of "percentage of rating," would be closer to the second set of figures than the first.

With combination group and automatic control, the ease of manipulating the boiler has been marked. Means have not been available for making any actual test, but the high CO_2 and the low stack temperature of the gases indicate good efficiency.

EVAPORATION PER SQUARE FOOT OF HEATING SURFACE

Evaporation per square foot of heating surface based on surface of	Total Output in Pounds— 200,000	250,000	300,000
Boiler, furnace and economizer	11.17	13.97	16.76
Boiler and furnace	22.11	27.63	33.16

A PIONEER INSTALLATION of high-pressure machinery was fitted last year in the Clyde steamer "King George V," having a power of 3,500 shaft hp. on two shafts, a boiler pressure of 550 lb. per sq.in., and the steam superheated to 750 deg. F. The experiment on this vessel was made to demonstrate a higher efficiency, to explore the practical application of high temperatures and water-tube boilers to marine work, and to ascertain what practical difficulties, if any, had to be overcome. The experiment has shown that there are no difficulties in the way of such installations which cannot be met by suitable provision.—*Engineering, Jan. 21, 1927.*

Keeping the Motor on the Job

By C. O. Mills

FAILURES of motors, when operating under conditions of oil, carbon dust and moisture, are too frequently accepted as unavoidable. There is little doubt, however, that most of these failures can be prevented by the proper maintenance methods. First, everything within reason should be done to protect the motor. Protection is generally cheaper than repair bills and the expense of having the motor out of service. After proper protection has been provided, inspections and maintenance must be relied upon to keep the motor in service.

Cleaning the Windings

Under very bad conditions it may be necessary to remove the motor from service every three or four months and thoroughly clean the winding with gasoline and then bake it in an oven through which there is good air circulation. After the winding has been thoroughly baked, it should be given a good coat of insulating varnish and baked again. If it can be done, it is best to dip the entire winding into the varnish while the winding is at oven temperature. The winding should be left in the varnish until the air bubbles cease to rise to the surface. Where this cannot be done the varnish can be sprayed on with compressed air.

Care should be used to get the varnish into all the corners between the winding and the core. Where the coils come out of the slots is a weak spot in all windings. There is generally more or less movement of the coil ends, and this is likely to cause cracking of the insulation where the coils come out of the slots. For the insulation varnish to be most effective, it should seal these cracks to prevent the entrance of substances that will destroy the insulation. If the winding has been allowed to get into bad condition, it may be necessary to give it two or more coats of varnish and a like number of bakings.

The foregoing treatment may require the use of a spare motor, but if taking care of the motors will prevent failures of the windings, the spare motor is a good investment. A complete rewinding of a motor represents a large part of the cost for a new one.

Ball Bearings Used on Motors

Where ball bearings are used on motors, there is little danger of oil getting out of the bearings onto the winding. With the old open-type sleeve bearings, which are in wide use, the windings are not so fortunate. Much can be done by putting felt washers around the shaft at the bearing housings, to keep the dirt out and the oil in. If the bearings cannot be effectively sealed, then the oil should be changed and the bearings washed out periodically. The length of these periods will depend on the conditions. In some cases, where the motors were subjected to dust, oil and high temperatures, the oil was changed every two or three months. Under less severe conditions every six months or once a year may be often enough to change the oil and clean the bearings.

On motors with open-type sleeve bearings, much can be done to keep the oil off the winding, by not flooding the bearings. Bearings should be carefully watched to see that they get the necessary lubricant but the oil should be kept down to a level where it will not run out of the bearings. Too frequently, motor bearings are lubricated by guess instead of exact knowledge of what is required. Oil is put into the bearings only to have it run out again and show that the bearing is full. If there is not an oil gage on the bearing, the amount of lubricant on the rings is a good indication of the oil level in the bearing housings. When the oil level is low, the ring will show a lack of lubrication and will run very freely and may even strike against the bearing with sufficient force to cause a metallic sound.

Checking Insulation Resistance

Among other things to be watched on a motor is the insulation resistance. There are a number of ways of measuring this resistance, but in the absence of these devices a 50,000-ohm magneto may be used to make a check on the quality of the insulation. As long as the magneto does not ring when connected between the winding and core of the motor, it is known that the winding has over 50,000 ohms insulation resistance.

The insulation resistance on most machines should be much higher than 50,000 ohms, but if a ring is obtained on the magneto it will be known that the insulation has deteriorated to a dangerous condition and something should be done immediately to restore it to good quality. The insulation resistance may be deteriorating over a long period before it gets within the 50,000-ohm region, but this cannot be detected with a magneto. For this reason it is advisable to use one of the well-known methods of measuring the insulation resistance and to keep a record of how it is holding up.

A periodical check up on the motor's load also is advisable, as this may save overloading and overheating of the winding. On some classes of equipment the friction load is high and can vary over wide range. If something happens to increase the friction load of the driven machine, the motor may be overloaded without anyone knowing it, unless tests are made. In other cases machines are added from time to time, and unless a check is kept on the motors they may become overloaded.

Much of the discussion on the care of motors may seem somewhat out of place, but the object is to get service out of these machines under the many conditions in which they have to operate, and foresight generally costs a lot less than hindsight and results in much better service.

THE RECENT ADOPTION OF SIMPLIFIED PRACTICE, sponsored by the United States Department of Commerce, for wrought-iron and wrought-steel pipe, valves and fittings, has resulted in a reduction from a total of 62 sizes to 49 sizes of pipe, corresponding to an elimination of 20.96 per cent and an elimination of 762 sizes and styles of valves and fittings, or a 3.8 per cent reduction in the current variety. When consideration is given to the equipment that is necessary to make these seldom called-for items, the causes for heavy overhead production costs for the manufacturers, the excessive storage and inventory expenses for the distributors, and the final cost to the ultimate consumer become obvious. One concern has stated that its sale of the 4½-, 7- and 9-in. sizes alone represents only one-third of the investment that is required to produce them, so heavily does the fabrication and stocking of the odd sizes drain their resources. If this condition characterizes the entire industry, it is plain that potential economies rest within this program.

Announcing the Judges

who will pass upon papers submitted in the

Power Prize Contest

dealing with power plant improvement

R. J. S. Pigott

MR. PIGOTT has had an extensive experience covering the design and operation of power plants in both the utility and industrial fields. This includes several years with the Interborough Rapid Transit Co., New York; power superintendent for the Remington-Arms U.M.C. Co.; superintendent of mills for the Bridgeport Brass Co.; works manager Crosby Steam Gage & Valve Co. and mechanical engineer with Stevens & Wood. At present he is consulting engineer for the Public Service Production Co. He is a graduate of Columbia University, a member of the A.S.M.E. Power Test Codes Committee, chairman of the A.S.M.E. Research Committee and author of numerous technical papers.

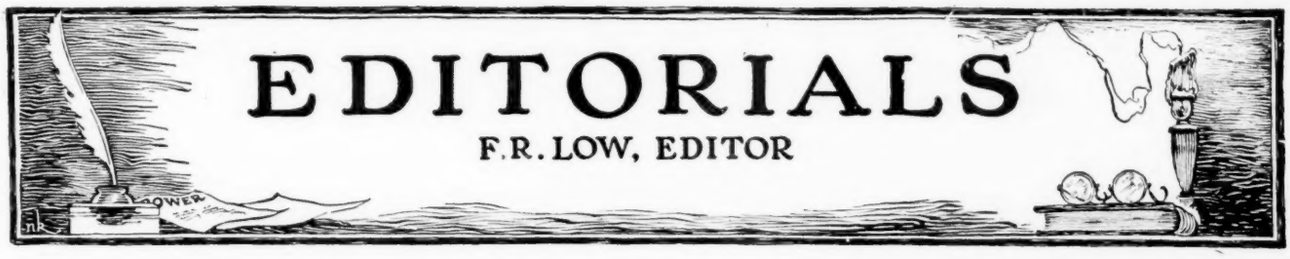
F. M. Gibson

AS an active worker in New England engineering circles and as the industrial power representative on the Executive Committee of the A.S.M.E. Power Division, Mr. Gibson is well known as an authority on industrial power. Following graduation from Stevens Institute, he spent several years with the Cambria Steel Co. and the San Carlos Copper Co., later coming with the American Sugar Refining Co., where he has had charge of design, construction, and operation of power plants and is now Plant Engineer of their Boston refinery.

A. C. Wood

FOR over thirty years Albert C. Wood has been a consulting engineer in Philadelphia, specializing in tests and investigations of steam plants and the design and construction of industrial plants, of various kinds, as well as power plants. His clientele includes many well-known mills and manufacturing establishments. He is a graduate of the University of Arkansas, in the class of 1892, a member of the Power Test Codes Committee, A.S.M.E., an associate member of the American Institute of Electrical Engineers and an active member of the Philadelphia Engineers' Club, as well as of the Franklin Institute. Readers will also recall him as an occasional contributor to *Power*.

POWER is gratified that Messrs. Wood, Pigott and Gibson have consented to act as judges in the Contest. Their broad experiences in the power-plant field especially fit them to pass upon the papers submitted, and their professional standing will lend weight to the decisions. The conditions of the Contest and awards are restated on page 512 for the benefit of new readers who may not have seen the previous announcements.



Tomorrow's Operating Engineer

SOME think the job of the operating engineer isn't what it used to be. Others find the business of running a plant one of continually expanding interest and opportunity. A study of present-day plants and conditions leads to the suspicion that such views are really little more than the measure of a man's ability to adapt himself to rapidly changing conditions.

The knowledge and experience once considered sufficient for the satisfactory operation of a power plant are no longer enough to get one by with owners who know their business. Engineering practice is rapidly changing, along with other phases of modern life. Higher pressure and superheats, high rates of combustion with stokers or powdered fuel, more stringent requirements in the matter of scale and corrosion, combustion-control systems, heat-balance layouts and many other developments call for a mental equipment not needed by the operating engineer of twenty years ago.

As a result men and plants are rapidly dividing themselves into two classes—those that are running down into a deep rut and those that are climbing to new peaks of economic performance and satisfaction. Only the latter can survive in the scientific era upon which we are entering.

The Propeller Pump

PROPELLER pumps have been used extensively for low-head service where large volumes of water must be moved. They have proved particularly suited for drainage service and for handling sewage where this has to be elevated a small height. It has also been stated that the efficiency of these pumps is high when they are properly designed and operated under suitable conditions.

Our large central stations are adopting turbines and condensers of increasing sizes, so that the problem of size and space for condenser circulating pumps is becoming a serious one for designers. It has been suggested that the operating heads of the condenser are frequently within the range of a propeller pump and that such a circulating pump might be used for this service.

Few power-plant engineers are familiar with the design and operating characteristics of this type of pump. It is said to work best when submerged, and this would involve the use of a vertical pump placed in the recess off the main cooling-water intake tunnel. This may also involve special scroll or curved approaches to and from the pump to give highest efficiency. The relation of depth of submergence to total pumping head should also be known. The power capacity characteristics of this type of pump differ from those of the ordinary centrifugal pump, and these must be known before such a pump can receive wide adoption.

The propeller pump may meet a real need in our large power stations. As previously indicated, if it has favorable features for this service, its performance characteristics and maintenance records must be made familiar to central-station engineers before it can receive wide adoption. This question is worth further discussion.

The Engineer and the Bookkeeper

THE engineer changes his equipment or operating methods to save money for the firm. The accountant compiles the figures that show the saving—or perhaps they don't.

For example, here is a little power plant, exhausting to atmosphere, with an adjacent boiler room furnishing steam to the factory for process heating at fifty pounds gage pressure. The engineer knows that this is wasteful and finally persuades the owner to let him install suitable bleeder or back-pressure turbines and use the heating steam to generate power on its way to the process task. Having succeeded in making this improvement, the engineer returns to his task of keeping the plant going, content that he has done a good turn.

And then the trouble begins. Somebody discovers that the power plant is charged with more steam than it was before the change. How can this be a saving? The engineer may easily be up against a tough argument, doubly difficult because his opponent, the accountant, and the judge, the owner, probably both lack even an elementary understanding of the engineering aspects of the situation.

Of course, for the simple case assumed here for illustration, the solution is not difficult. Instead of charging the power plant with more steam, credit the heating process with power generated by the steam in passing. In other cases, indeed it may be said in any real case, the matter is not so simple.

Accounting is a complex art, perhaps more complex than the engineering of the simpler steam plant. And it is on the basis of the accountant's work that the engineer's ability is judged. Ordinarily, the accountant knows no engineering and rather thinks the power plant a bit too dirty for him; and, on the other hand, the engineer knows nothing about accounting and is inclined to look upon the accountant as a sort of useless beneficiary of the boss's indulgence. Of course both are wrong. The accountant should know what his figures represent, and the modern accountant who is worth his salt takes pains to learn all he can about what goes on behind the scenes in his plant. And the engineer should know something of what becomes of the records he establishes for others to keep track of. These two men should be friends, understanding each other sufficiently to explain their mutual problems and to ask intelligent questions.

The only way to accomplish this necessary understanding is for the two men to get together, and if one won't begin, the other must. Why shouldn't the engineer invite the accountant to visit the power plant and advise how operating records may best be kept so as to serve the needs of the accountant most effectively? A little yielding on both sides may save a lot of fighting some day.

The Fiftieth Anniversary of Die Wärme

POWER congratulates its contemporary, *Die Wärme*, on the completion of fifty years of life and leadership in the steam-boiler field. The journal appeared in January, 1878, but it is not now fully understood that it owes its origin to the organization of steam boiler inspectors' societies. It is in a way a part of the history of these societies.

Shortly after the Prussian societies were granted official power to supervise the inspection of the boilers of their members, there arose in 1873 the first association of inspectors' societies, which grew rapidly from an association of eight societies with a few thousand boilers to a powerful body covering all Germany, and finally to the International Association of Steam Boiler Inspectors Societies, comprising in 1913 seventy-two societies and some 265,000 boilers.

Early in the life of the society it became apparent that its work could best be forwarded with the aid of a journal devoted to the needs of its members, and finally, in 1877, agreement was reached, and after many difficulties a start was made with the appearance in 1878 of the first monthly issue under the title *Mitteilungen aus der Praxis des Dampfkessel- und Dampfmaschinenbetriebs.*

With the organization in 1888 of the International Association of Steam Boiler Inspectors, this publication became the organ of that body. In 1901 it became a weekly, and shortly thereafter the publication was taken over by Rudolf Mosse, Berlin, first as the *Zeitschrift für Dampfkessel und Maschinenbetrieb*, and later, since 1922, as *Die Wärme.*

Power wishes for *Die Wärme* another fifty years of shining success.

Appraising the Cost of Plant Operation

WHEN comparing the cost of purchased power with that generated in an isolated plant, there are two general conditions that must be kept in mind. The first is where the plant is not built, and the other has to do with an existing plant that will be shut down if power is purchased. If estimates are being made on which to base a comparison of power cost in a new plant with purchased power, then everything that enters into the cost of producing the power should be included, overhead as well as operating charges. In this case the capital has not been invested in the plant and is available for other purposes if the plant is not built.

Where the plant is built and in good operating condition, a large part of the overhead charges should be eliminated from the cost comparison of the two methods of obtaining power. The investment has been made, and if the plant is shut down it probably will bring only junk value and maybe not that. Therefore, if the capital charges are to be included in the cost of power if the plant is not shut down, they should also be included in the cost of the purchased power, consequently this charge cancels in the comparison.

Obsolescence is another factor over which there is much misunderstanding, and it varies through wide ranges. In central stations, where improvement in power-station design and changing load conditions are influences, a plant may become obsolete in a comparatively short time. On the other hand, in certain classes of industrial plants that have been properly designed for the load they are serving, obsolescence is practically negligible if the plant is maintained in good condition. Some plants that have been in service for twenty-five or more years, are in as good condition today as when installed. They are also as well adapted to the load conditions as when first installed, even so much so that when new engines are installed types similar to the old ones are selected. As far as can be seen at the present time, nothing will develop in the methods of power generation that will warrant changing the equipment in these plants. Under such conditions there seems to be little justification of obsolescence charges in the power cost of a plant.

Taxes, insurance, amount of labor saved and space made available by shutting down a plant are factors that are frequently given undue emphasis and lead to excess charges being made against the plant. There are certain kinds of insurance that are chargeable to the plant, where other classes are probably not affected at all. The question of charging for the space occupied by the plant is also a controversial point. In one case this space may have a high rental value and be badly needed, while in others it will not be used for any other purpose. In the latter event, there is no reason for charging the plant with the space occupied, for nothing is saved by shutting it down. Furthermore, the space required by refrigerating machines, pumps, switchboards and the like, frequently prevents taking advantage of the space made available by closing down the power plant.

Oil Power Week

FREQUENTLY, engineers not residing close to large centers of population, feel that they are out of touch with things. As it is impossible to travel long distances to attend engineering meetings, it must be conceded that a handicap does exist.

Judged by records of previous years Oil Power Week is to be a successful attempt to bring to engineers scattered throughout the country, speakers who are able to discuss various phases of oil-engine practice in an authoritative way. Since this movement is supported by the various engineering societies and is free from commercial propaganda, a great amount of open and honest engineering facts should be brought to light during the week.

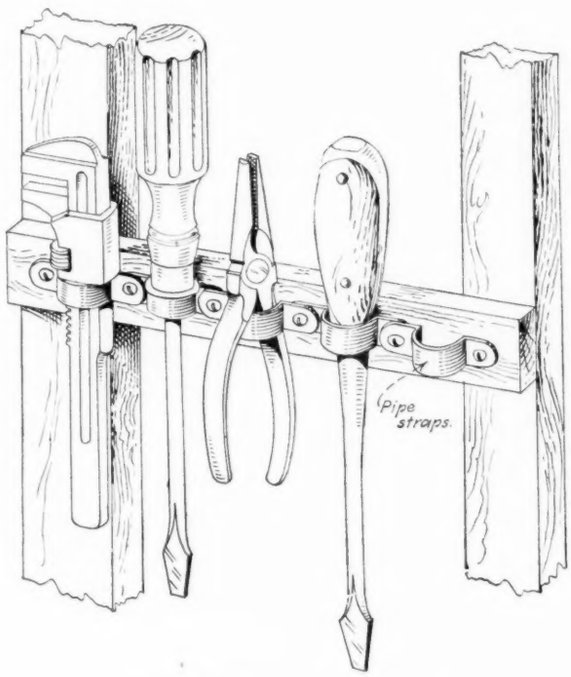
At the present time over one hundred meetings have been definitely arranged, and indications point to a probable total of more than two hundred. Among the outstanding meetings is the three-day conference at Penn State College. The research department of this university has made investigations in certain details of oil-engine design. The results will be discussed at the conference at which a number of nationally known men will speak. Other schools have like ambitious plans, while the several engineering societies have arranged local and regional meetings.

Ideas From Practical Men

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted.

Pipe Straps Make Handy Tool Rack

A rack made of miscellaneous sizes of pipe straps, as shown in the illustration, makes a handy resting place for small tools around the engineer's work bench. Such tools as screwdrivers, chisels and pliers, may be



How the straps are arranged

hung within convenient reach. Each may have its proper place where it will be on the job whenever needed.

To make the rack nail a piece of 1x2-in. board about ten or twelve inches higher than the bench. To this strip nail or screw the pipe straps, one lapping over the other. Provision can be made for many different small tools by using the several sizes of pipe straps.

Syracuse, N. Y. H. L. WHEELER.

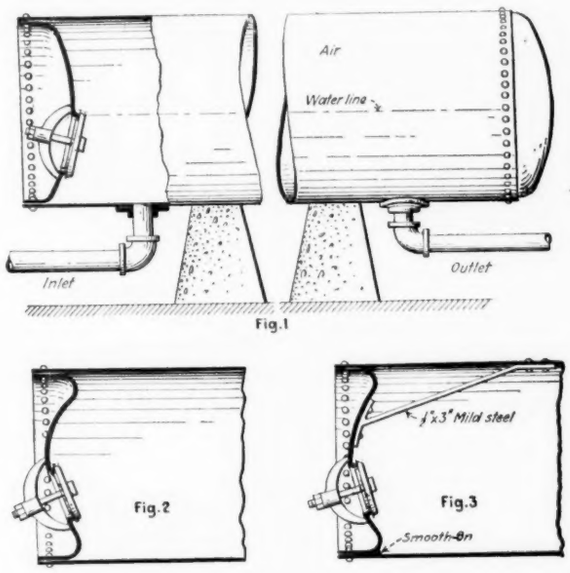
Why the Tank Failed and How It Was Repaired

It occurred to me that other engineers might be interested in an out-of-the-ordinary failure of equipment and the means taken to get it back in service.

A pressure tank for house water service 66 in. by 20 ft., Fig. 1, is used to furnish water for factory use, both shop and power house. This tank had been in service for years. The plant had expanded and larger pumps had been installed, but no provision was made for over-pressure relief. As a safety measure the chief had put a bypass around the tank so that the water could be pumped directly into the service mains in case of accident to the tank.

After years of service the inevitable happened. The motor-driven duplex pump serving the tank cut in at the customary 30 lb., but did *not* cut out at 41 lb. as it was supposed to do and had done for years. It kept merrily on till something had to go. A hasty inspection after the accident showed that the head of the tank had been forced outward as shown in Fig. 2. The first thing to do was to get water, so the bypass was brought into use and water pumped into the mains by a steam pump.

The water supply taken care of, the next thing was to repair the tank. A boilermaker was sent for and it was decided to try a repair. The cast-iron manhole plate was cracked in three places, so it was sent to the welding shop. In the meantime the forging of 14 crowfoot braces to extend from the head to the shell, Fig. 3, was started. While this was in progress, the boilermaker



How tank was repaired after damage from overpressure

and his helper endeavored to drive back the manhole, which was flanged out of the head. As soon as the manhole cover was welded, it was tried in place and found a fair fit; the high spots were ground down and the work of putting the braces in started.

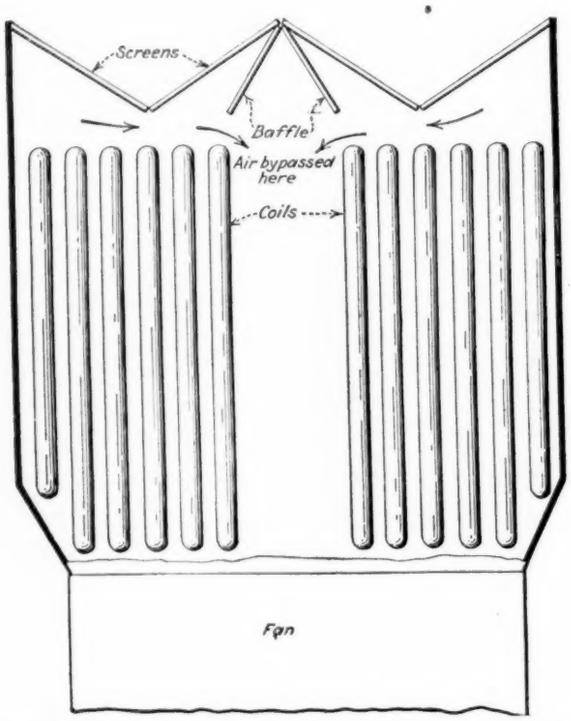
Each brace was fitted and put in and the whole drawn tight. The old rivets in the head were all stretched, so a packing of Smooth-On No. 1 was calked in all around the head. An hour after the repairs were finished, the tank was put into service and so far has given no trouble. Incidentally, a relief valve and alarm gage have been installed, and we expect some years of service yet out of the old tank. S. W. STEARNS.

Beloit, Wis.

An Indirect Heating Problem

While an erector of ventilating equipment, I received a complaint from a plant about 50 miles distant regarding trouble with a fan and a set of coils that were supposed to deliver 140-deg. air to the finishing room of a mill.

On my arrival I was told by the engineer that he had increased the fan speed by 50 per cent in an endeavor



Arrangement of heating coils with screens and baffles

to maintain the production schedule, and even with the pressure in the coils increased from 10 to 30 lb., the fan and heater could not meet the guarantees. In addition the fan belt slipped badly and power consumption increased enormously.

I first looked at the intake screens and found them clean, showing there was no throttling on the suction side and all steam and return valves were wide open. Finally, I ordered the removal of the screens and the source of trouble was evident, though unsuspected by the ones responsible for it.

Machinery was being installed on the next floor, and to support the extra weight, four 6x6-in. timbers were carried up from the floor of the fanroom. Two of them had to be placed close to the steam coils, and to make room the screens were set 8 in. away from the coils. The coils were built in two sections with a space between just wide enough for a man to enter for the purpose of cleaning.

With the screens in proper position a narrow baffle carried on the screen forced the entering air to travel over the entire heating surface before reaching the fan. But as shown in the sketch, placing the screens 8 in. from the coils allowed the air to follow the path of least resistance toward the fan, this path being the space between the two sections. As a result at least 50 per cent of the air went directly to the fan and diluted the air from the coils, causing a large temperature drop at the fan-discharge outlet. Placing sheet-metal baffles at the center of the screens directed the air into the right channels and gave the correct discharge temperature. As the pressure in the outlet was higher than necessary, the original fan pulley was put back and the speed reduced to that for which the fan was originally designed.

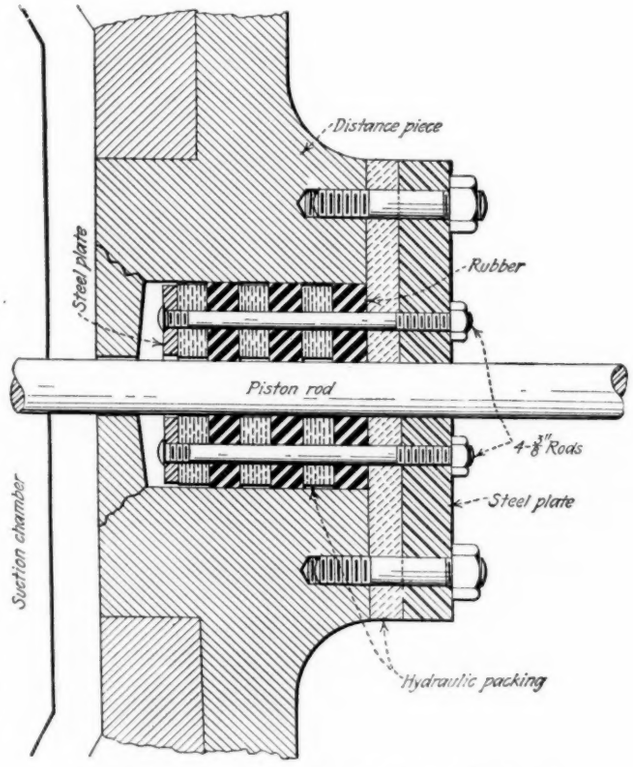
With these changes the production of that department increased and all trouble from belt slippage, formerly due to excessive belt tension, was ended and the power consumption of the fan dropped more than half.

Thompsonville, Conn. G. H. HART.

How Packing Was Held in Stuffing Box After Bottom Was Broken Out

The illustration shows the repair made to a broken stuffing box in the centerpiece of a 250-lb. pressure duplex water pump. The bottom of the box was broken away as indicated, and as it would take considerable time to disassemble the pump and have the piece welded or a new one installed, the method of repair shown in the illustration was adopted.

To form the bottom of the stuffing box, a disk was cut from a piece of boiler plate and made a neat fit in the box and with good clearance around the piston rod.



Method of tightening packing in stuffing box

Another plate of larger diameter was made to take the place of the gland flange. Then the regular piston-rod packing was assembled between these plates and drawn up with four ⅜-in. bolts secured in the bottom plate as shown.

This method of repair gave satisfactory results and obviated the necessity of having the pump out of service for considerable time. C. H. PAEPLOW.

Buffalo, N. Y.

Comments from Readers

Permanent Line and Level Marks in the Power Plant

Mr. Naylor's article in *Power* for March 8, 1927, page 379, recalls to me a somewhat similar means employed in one power plant to leave permanent records.

During construction a pipefitter foreman of wide experience, on his own responsibility, had deep center-punch marks placed by the engineers on the construction job on certain of the vertical steel beams at various floor levels. Each of these marks located a point 5 ft. above the true floor level.

When he later became the operating department's pipe foreman at this plant, he was able to reap the benefit of his act. As is always the case, the surface of the concrete floor was not at the true floor level by any means, nor was the floor thickness uniform. However, by reference to the location points he had so carefully made, and to the blueprints of the station, his piping in any new run or layout could be scaled off accurately before installation, without any intricate or approximate measurements.

On many jobs that I saw this man do, using these marks, there was not one on which any pipe had to be recut, and the saving in expense thus made must have many times repaid "Pat," as we knew him, for this bit of forethought.

CHARLES E. COLBORN.

Jeannette, Pa.

Boiler-Shell Joints, Rivets, Welds and Dovetails

The following thoughts on boiler-drum fabrication were inspired by Professor Christie's letter in the Jan. 25 issue, wherein he advocated substitution of welded joints for riveted joints.

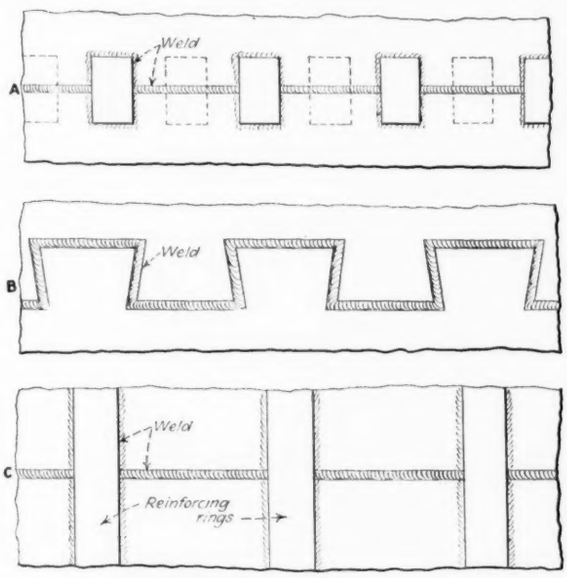
Undoubtedly, Professor Christie's interest in this matter arose from his studies of boiler-plate embrittlement. It is known that this condition occurs by the metal absorbing nascent hydrogen induced by the reactions in either strong acid or alkaline solutions. In ordinary boiler operation the concentration of the solution never reaches the necessary density except under lap seams and rivet heads. The welding of plate joints would be an excellent remedy if an absolutely reliable weld could be assured.

The future of welded joints in boilers rests upon the condition that welded joints must equal riveted seams and not cost more. Welds must be accessible and repairs easily made. The holding of the plates in position while welding must be as good as when the rivet holes are possible. The point of paramount importance is that the finished weld must be perfect beyond any doubt. Under present conditions it is not satisfactory to depend on the skill of the operator.

The forge-welded scarf joint employed in Germany appears not quite satisfactory. This method appears to be simple and cheap. If successfully applied, such a joint should be as strong at the weld as in the metal plate and consequently must be as strong as when forged in a single piece. There is a difficulty in holding the welding heat in large sheets and an uncertainty of continuous fusion.

The oxyacetylene process causes a considerable area of the plate to be heated and sets up internal stresses in the metal adjoining the weld.

E. Höhn, chief engineer of the Swiss Boiler Owners' Association, reports in *Zeitschrift des Verein Deutscher Ingeneure*, Vol. 20, page 117, some boiler-welding experiences. He claims that the oxyacetylene method is difficult and sometimes impossible. He suggests an oxyacetylene weld along the joint and with the opening filled by the electric-arc method. He depreciates lap



Welded drum seams

A. Seam with small reinforcing plates as used abroad. *B*. Dovetail joint suggested by the author. *C*. Welded seam reinforced by rings.

joints and butt welds with single cover plates. The lap seams cause a great bending stress and give more difficulty in joining on the heads. He approves the small individual inside and outside cover plates as shown at *A*. They seem to adhere so firmly that on test they break through the center. While they strengthen the weld, they add a considerable amount of welding and are something of a makeshift.

Lloyds forbid butt welding, although it has been found by tests and actual practice that it is superior to overlap. The former would also appear to be the simplest and cheapest method.

Before it can be considered commercially possible to adopt welds in boiler seams, two requirements must be met:

1. The weld must be shown to be absolutely sound to satisfy insurance companies and to make sure of their approval.

2. The welding of plate joints must be able to compete economically with riveted joints.

There is little hope of welded boiler seams being adopted until the uncertainty of the human element can be eliminated. The welding must be done by automatic means and examination made simple and thoroughly reliable.

The joint should be made mechanically secure by some interlocking or dovetailing of the plate sheets as shown at *B*. Otherwise reinforcing ribs or rings should be shrunk on and securely welded as shown at *C*. These are preferable to the small cover-plates.

The stresses must be thrown out of the joint if possible. The filling in of molten metal can be considered only as the inserting of a cast section, adhering to the adjoining metal by an uncertain fusion. Welded surfaces will require to be properly machined to give clean surface for homogeneous joints. Metal used in welds must have non-corrosive tendencies, and the finished job will require proper annealing.

To sum up, if the use of welding is solely to avoid the embrittlement dangers in riveted seams, there is little chance of it being adopted. This difficulty can be overcome by welding inside of the seams and rivet heads and maintaining a correct condition of the boiler water.

J. M. BRENNAN.

Jersey City, N. J.

Experiences with Zeolite Softener

Regarding Mr. Maconnell's query in the Feb. 8 issue about Zeolite-softened water for makeup, it has been my experience that if one is careful about reclaiming the brine after backwashing, the water will be satisfactory, but if the job of regenerating is left to some of the helpers to do without supervision, one is likely to encounter corrosion.

I have found it necessary to use very little softened water, owing to getting plenty of returns from heating and other lines, and as the water here and in New York State is not the same, I would suggest that Mr. Maconnell get in touch with someone in his vicinity as to his experience with softeners of this type.

Santa Barbara, Calif. C. W. STONE.

How To Prevent Carryover

The article on this subject in the March 15 issue of Power should be of interest to power-plant engineers. It is becoming recognized that concentration of impurities in boiler water is the cause of scale formation, dirty steam, priming, corrosion, caustic embrittlement and other troubles. After a study of boiler-water concentration, I have come to the conclusion that the nature and amount of all impurities in boiler water can be controlled, thereby practically eliminating the troubles resulting from this cause.

Priming is probably the easiest boiler trouble to prevent, as it can be stopped by keeping the concentration below a certain point. Reduction of concentration still further will result in the production of cleaner steam and practically pure steam will be obtained.

It is known that nearly pure water will remove scale from the boiler and if the degree of concentration is kept low, the formation of scale can be practically prevented. There are, however, certain scale-forming materials that require the carrying of an exceedingly low degree of concentration to prevent trouble. In these cases the use of a small quantity of the proper chemical is advisable. It is well known that the simplest method of decreasing concentration is to blow the impurities out of the boiler or else not to put them in the boiler in the first place.

As a result of study of the matter I have come to the conclusion that there are several elements to be considered in determining the blowdown required to get a concentration to produce a certain result. For instance, if the object is to prevent priming, it is evident that the area of the water-steaming surface, the boiler pressure and the boiler horsepower developed must be taken into consideration. On this basis the formula shown in the accompanying chart was derived. Curves showing the priming point for different boiler conditions have been plotted from this formula, and on the same chart

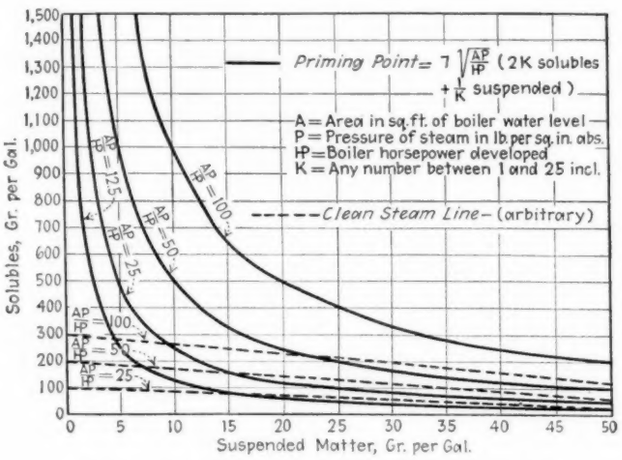

Priming Point = 7 √(AP/HP) (2K solubles + 1/K suspended)
A = Area in sq. ft. of boiler water level
P = Pressure of steam in lb. per sq. in. abs.
HP = Boiler horsepower developed
K = Any number between 1 and 25 incl.
Clean Steam Line – (arbitrary)
AP/HP = 125
AP/HP = 100
AP/HP = 50
AP/HP = 25
Solubles, Gr. per Gal.
Suspended Matter, Gr. per Gal.
0 5 10 15 20 25 30 35 40 45 50
0 100 200 300 400 500 600 700 800 900 1,000 1,100 1,200 1,300 1,400 1,500

Chart for determining blowdown required

arbitrary lines indicate the concentrations that would give clean steam under the certain conditions indicated. Curves showing the scaling point are not shown, as this is determined best by trial. These methods are used by me in operating the plants coming under my jurisdiction.

ROY O. HENZEY.

Oconomowoc, Wis.

Freeing Piston Rings

In his article on the freeing of carbonized piston rings, appearing in the March 15 issue of *Power*, A. B. Newell describes a method of boiling the pistons in lye water and follows it with the statement, "Subsequent developments led me to wonder whether the heat alone would not have done the trick."

My own experience under similar conditions convinces me that the application of heat alone would have freed the rings equally well and much quicker. Some six years ago I had occasion to run some tests with low-grade fuel oil on a large Diesel engine under varying conditions of operation. Under the conditions required for some of the tests the collection of residue around the piston rings was so great that removal of the pistons from the cylinders was very difficult. After the pistons were removed, they had the appearance of solid, cylindrical plugs, owing to the rings' being embedded in what appeared to be hard carbon. Attempts to remove the rings by any of the usual means without breakage proved futile, but we found that if the flame of a small Hauck burner was played on the piston for

a few minutes, the deposit would soften up and the rings spring free, permitting easy removal in the usual way. It is worthy of note that the residue while in its heated and softened state was easily cleaned from the rings and slots with kerosene, although the kerosene had not the slightest effect on it in the cold, hard state.

Apparently, the heating method will be equally as effective as the boiling method described by Mr. Newell and will be much quicker and cheaper.

New York City. LOUIS R. FORD,
Consulting Engineer.

The Commercial Efficiency of Fuel Burning Equipment

The cost of producing a given amount of steam is the ultimate criterion by which any fuel or coal-burning equipment must be judged. It takes into account the initial costs of land, building and equipment, operating

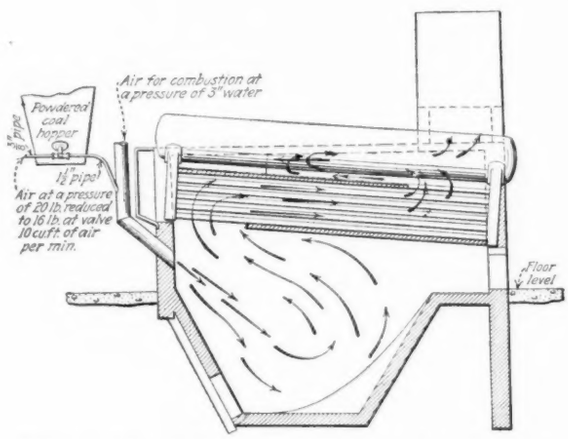

Air for combustion at a pressure of 3" water
Powdered coal hopper
1/4" pipe
1/8" pipe
Air at a pressure of 20 lb. reduced to 16 lb. at valve 10 cu.ft. of air per min.
Floor level

Fig. 1—One of the early boilers equipped to burn pulverized coal

and maintenance costs, also taxes, amortization, insurance and other fixed charges. It is termed commercial efficiency.

Considering some of the modern steam generating stations that have been placed in operation within the last few years, it is surprising to observe what a small proportion of the total cost is represented by the generating equipment and how large the structural investment. One could believe that the relative term of comparison might have been omitted from the computations. An editorial in the Jan. 1, 1927, issue of *Electrical World* entitled "Costs of Modern Stations Affords Food for Thought" points out that the structural expense, including foundations, circulating-water tunnels, etc., comes close to 40 per cent of the total cost.

Power-station construction involves numerous problems and a varied field of application, taking for example, the progress of fuel burning, which is so rapid that it is becoming a matter of ever-increasing difficulty to keep abreast of the modern developments. The volume of data surrounding each project is so enormous that few can hope to read, far less assimilate, all that is said when purchasing fuel-burning equipment.

During 1913 the American Locomotive Co., at the Schenectady works, installed the Quigley systems of pulverized fuel for forge furnaces and also equipped one 3,000-sq.ft. water-tube boiler. The exact design of the setting is shown in Fig. 1. The boiler operated from 1915 to 1921 with practically no maintenance, and good thermal efficiencies were maintained.

The successful operation[1] of the boiler has been attributed not only to the construction of the furnace, the design of short flame burner and proper amount of direct heating surface, but to the proper control of flame.

In spite of the actual success this powdered-coal boiler, and other 20-year old boilers were removed and replaced by modern boilers stoker-fired.

Obviously, this action was severely criticized by many who were not acquainted with the company's practice of viewing all expenditures for additions and betterments from the financial angle or commercial efficiency, which would show that the savings made by the storage systems of pulverized-fuel firing would not be sufficient to offset the charges for capital investment.

During the six years that the boiler was in successful operation, engineers from practically all over the world visited the plant, and promptly other companies installed the storage system of pulverized fuel. One central power station conducted tests to determine the economical value of the storage system of pulverized fuel and view the problem from the results summarized in Chart Fig. 2, as follows:

Costs of coal per ton as purchased, cost of coal per ton as burned, gross thermal efficiency; net thermal efficiency, including incidental costs. No reference was made to the initial costs of building space, equipment,

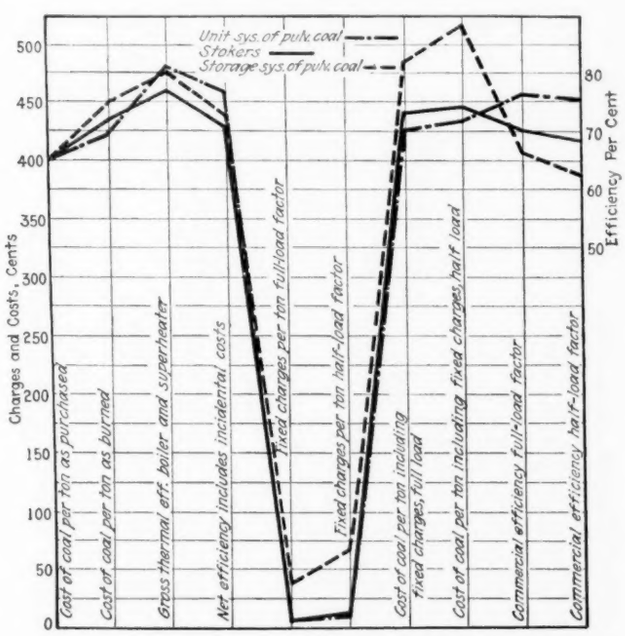


Fig. 2—Chart showing commercial efficiency of fuel burning equipment

land, load factor, etc., which affect the earning power of the dollar from 7 to 12 per cent, according to the fuel-burning equipment that is selected. It follows that 7 to 12 per cent equivalent to coal may be wasted owing to improper selection of equipment.

I have had the opportunity to report on many stations during the last twelve years. The chart Fig. 2 represents average conditions. The commercial efficiency will decrease 3 per cent with coal at $2.50 per ton, or would increase 3 per cent with coal at $6 per ton.

New York City. J. GOULD COUTANT.

[1]Bureau of Mines Bulletin No. 237, page 64.

Engineers Show Interest in the High-Speed Diesel

THE high-speed Diesel is a proved commercial success, so engineers claim. The particular points of design and limitations of application were covered at the Feb. 25 meeting of the Metropolitan Section of the American Society of Mechanical Engineers.

TWO papers read before the Metropolitan Section of the American Society of Mechanical Engineers at New York City, Feb. 25, dealt with the design and commercial aspects of the high-speed Diesel.

H. F. Shepherd, Diesel Engineer, Bessemer Gas Engine Co., stated that there is, strictly speaking, no school of high-speed oil-engine designers as yet. Automotive engineers, with a supply of gasoline still available at a fair price, have not in any great number given study to fuel injection. It has consequently fallen to the lot of Diesel-engine designers to acquire the necessary training to build engines to operate at high speeds. The demand for these engines is not the result of promotion and may be regarded as a healthy product of the times.

Workmanship Required

Increasing the speed of the Diesel engine has brought out nothing novel in a thermodynamic way. If testing reveals anything, it is only the necessity for wearing surfaces of genuine high-grade workmanship, for first-class metals properly heat-treated and the general design practice already well established in the automotive field.

The injection timing for high speeds is little if any earlier than for slow speeds. The natural turbulence of the air charge seems to be stronger even at the same valve-passage air velocities. This is perhaps because less time has elapsed to damp it out and is a pleasant surprise, as it removes one fear of the pioneer in this line—that the time interval would be too short for combustion. Maximum pressures tend to run higher, and it is well to design for 750 lb. rather than for 600.

The most conscientious work will be required if our high-speed engines are to have a life of as many revolutions as our older slow-speed engines. Forces due to rotation and reciprocation increase directly as the square of the revolutions. In the case of the valve gears, much can be done with design, workmanship and lubrication of the pin bearings, but connecting rods and pistons are already developed as regards bearing metals and lubrication to the best of our present-day knowledge, so reduction of weight is essential. If this is carried too far, life will be short, of course.

Cost of Manufacture

It is quite obvious that a high-speed engine will be cheaper per horsepower if constructed to smaller although sufficient dimensions, of the same materials as are used for heavy engines.

If extra light weight is a further requirement, aluminum or steel castings can replace gray iron for the main structure. Aluminum alloys can replace at the most but three times their weight of cast iron and usually but one-half. Their cost will be not much less than 60c. per lb. Multiplying iron foundry costs of prices by two or three will by no means offset this figure. Steel castings for bedplates are not definitely quoted, but have been tentatively offered at 25c. per lb. with reservations for future orders. These are frequently half as thick as one would use confidently in gray iron, but their use is still not economical and the supply is as yet precarious. Malleable-iron bedplates are being made in numbers for engines of moderate size, but the foundries are not ready to undertake anything larger. Their annealing equipment will not take the work, and the distortion causes too many losses or the expense of too much care to make the job a very profitable one.

Design of Reciprocating Parts

Regardless of what cost considerations may govern the main structure, the weights and designs of the reciprocating parts, piston and rod are fixed by the speed, although two strings of parts, a light set for high speeds and a heavy set for more moderate speeds, may be used with the same engine design. Experience has shown that the mean terminal inertia force should not exceed 100 lb. per sq.in. of piston area.

The speaker stated that he had used, quite successfully, a conventional tubular forged steel rod with a conventional crankpin box of aluminum alloy lined with babbitt. The box was first tinned with aluminum solder and then with "half-and-half" solder and heated before pouring. Tinning was done with a rotating wire brush using tin and no flux.

If the other engine organs are suitable for increased speed, the use of alloy pistons, by permitting higher speed and rating in the ratio 1.41 to 1, is economical. They are perhaps not as durable as cast iron pistons in normal use, but in case of too close fitting or overheating they are far less likely to ruin liners by scoring or to part rods by piston seizure. The crowns must be supported, as the metal does not retain its strength above 600 deg. F. It is also very elastic and of coarser structure than gray iron, so fatigues if subjected to frequent flexing at high temperatures. The Butler alloy piston with its steel bands overcomes any expansion difficulties.

For the same reason that the rotating end of the rod should be light, the crankpins should be as light as possible, particularly so as two throws operate on the center bearing, but due consideration must be given to torsional stiffness. It was once considered practical to pass through one or more criticals in the operating range, avoiding continuous running at these speeds. Today, rotating and reciprocating machinery designers prefer to avoid criticals altogether. Short shafts of large dimensions are the order of the day. Crankpins should be hollow to reduce centrifugal weight and the moment of inertia of the shaft weight. Light stiff shafts and light reciprocating parts are most effective in raising torsional criticals. By the use of the babbitt metal developed by the Bureau of Standards, maximum pressures as high as 1,750 lb. per sq.in. can be imposed on the crankpin without grief of any sort.

Details of Construction

If the lightest possible engine is required, the hung shaft is an essential feature of the design. Bearings are perhaps more easily fitted and replaced from below than in case of the conventional type, in sizes up to about 9-in. bore.

The most significant point in shop practice necessary to high-speed work is the reversion to the practice of lapping and the enlarging of grinding operations. Breaking-in large high-speed engines with a motor is not satisfactory. They should be so finished that little "wearing in" is required. Ground or "honed" cylinders may be run in under their own power without scoring of iron pistons or damage to aluminum-alloy pistons. This is by no means uniformly possible with bored or reamed cylinders with small clearance. Both ground and honed cylinders have been used at high speeds with satisfaction.

Lapping has also been extended to cam rollers and pins, to pump plungers, spray needles and even to valve seats, with great satisfaction. Valve seats have been produced holding 4,000 lb. fuel pressure without any hand grinding whatever. No great amount of training is required if the simple governing principles are followed. The plan is to start a job with almost 100 per cent bearing surface rather than to assemble parts gaged over high spots, only to find them too loose after they are run in, also to avoid much hand fitting, which causes engines to vary in service or performance with the fitter's skill.

Most of today's efforts are centered

in engines of 7- to 9-in. bore. It was he speaker's experience based on actual estimated designs that serviceable engines will weigh about as follows:

At 600 r.p.m.—All iron and steel with hung shaft, 40 to 60 lb. per horsepower.

At 600 r.p.m.—Aluminum and steel, 25 to 30 lb. per horsepower.

At 900 r.p.m. weights should be reduced in proportion to the increase in speed.

Paper by R. C. Burrus

In a paper covering the commercial advantages of the high-speed Diesel, R. C. Burrus, of the Foos Gas Engine Co., showed a number of slides of the Foos high-speed Diesel. In dealing with speeds he stated that internal-combustion engines operating on the Diesel cycle or a modification of it, have in recent months operated at speeds in the neighborhood of 1,700 r.p.m. It is quite possible that, in the seclusion of the laboratory, inventors and designers in moments of unusual bravery have held governors in restraint to permit speeds far beyond this. Furthermore, Diesels of sound commercial possibilities are on the market with speeds up to 1,000 r.p.m.

The bare difference in fuel cost per gallon is but a part of the saving that gives the Diesel a decided advantage. A gallon of fuel will operate a Diesel-driven yard-and-a-quarter drag-line at least nine minutes longer than will a gallon of gasoline operate the gas-engine rig. Forty gallons of gas represents 10 hours' running in one case, while a like quantity of crude oil represents 16 hours' running time in the other. This indicates how the real savings pile up all along the line. The same quantity of fuel in the form of crude oil does more work, cuts down transportation and handling as well as storage and complementary operating costs.

Expected Life of Engine

Anticipated useful life is another saving favoring the Diesel. Gasoline engines have so limited a history in the industrial field that engine life compared to the life of the machine upon which it is mounted or which it powers, has not been very accurately determined. It is readily admitted, however, that gas-engine life is considerably less than the equipment it drives. In one particular size and class of contractors' equipment, credited with eleven years' life, gas-engine replacement has been calculated at approximately 2¼ times. On the other hand, with its generally sturdier construction, the Diesel should safely equal and very likely outlive the usefulness of the mechanical equipment it may drive.

In the smaller sizes the cost of the Diesel is materially more than the industrial type of gas engine, but above the ranges of, say, 100 b.hp. the initial cost difference narrows down very rapidly. Even in the small sizes the savings and economies of the heavy-oil engine offsets price difference so greatly that the question of cost is decidedly secondary.

Light weight may be listed as a prime essential. In the passenger rail car, or switching locomotive, every pound taken from the engine means reduction in total car weight, permitting pulling just that much more useful load, or revenue tonnage. Extreme light weight, on the other hand, is not so vital in other lines of mobile or semi-mobile equipment—for instance, the power shovel or crane where it is necessary to ballast the frame opposite the boom end. Here the use of the Diesel instead of the gas engine saves a little in the cost of ballast.

Space minimizing as affected by engine length is vital in the rail-car application, since each foot of length takes up revenue space, or adds to car length, in turn increasing car weight, an item that must be kept down. In the industrial or switching locomotive the number and bulk of the necessary auxiliaries dictates keeping over-all engine dimension within the strictest limits possible. Since in all applications where the gas engine is to be replaced by the oil engine, the available mounting space is limited, the latter's over-all measurements must be restricted.

Available types of the high-speed units are all solid-injection. As to how closely their cycle matches the accepted definition of the Diesel cycle, that is another question. The interesting fact is that they burn heavy oil, and combustion is the result of heat of compression. Several types of solid-injection systems are used on the few high-speed Diesels that are now commercially produced.

Engine Must Be Sturdy

Operating conditions on a shovel, a rail car, a logging machine or an oil-field drilling rig are far from ideal. The engine must stand alone, unsupported by the comparatively well-equipped repair shop of the stationary installation. Necessarily, the high-speed engine must be rigged and capable of standing more mistreatment than a heavy-duty stationary unit would likely receive in twenty years. Sturdy construction must be combined with accessibility. In the crowded quarters of the average industrial installation ease of access to engine parts cannot be overdone. The easier it is to get to valves, heads, pistons, shafts, bearings, etc., the more uniform will be the maintenance and general care. The human element injects itself forcibly into the matter of utilizing the high-speed Diesel, and accessibility will go a long way toward offsetting small operating difficulties that might arise. In other words, the unit must be foolproof or as near foolproof as possible. The number of engine parts must be held to the absolute minimum, working parts must be easily reached for service, and lastly, they must be of rigid design, eliminating the need of delicate handling and adjustment.

The Foos high-speed engine is a full-Diesel, four-stroke-cycle engine, using a solid, or mechanical, fuel-injection system. Its speed range goes up to 900 r.p.m. for ordinary applications. With cast-iron construction throughout, the weight per horsepower is as low as 40 lb. With the use of aluminum, steel castings, etc., this low weight is brought down to 30 lb. per horsepower and below without greatly affecting the cost of production. Carrying weight reduction to the extreme so affects production cost as to overshadow commercial possibilities completely, as has been indicated in the case of a unit of foreign design tried out in the railway field.

Fusion Points of Firebrick-Coal-Ash Mixtures

In the *Journal of American Ceramic Society* for September, 1926, L. C. Hewitt reports a study of the fusion temperature of mixtures made from six types of refractory brick with five types of coal-ash over a range of composition from 10 per cent brick, 90 per cent ash to 40 per cent brick, 60 per cent ash. High-ash mixtures were studied rather than high-brick mixtures, in the belief that boiler slags contain a relatively low proportion of the refractory. Sintered mixtures of refractory and ash tend to give higher fusion points than the raw mixtures do. Any determinations made in an uncontrolled atmosphere are exceedingly unreliable. The results obtained in this investigation indicate that the "cone-slag test" is of very limited value as a means of selecting refractories for boiler service.

Fusion points on the ash from the same coal do not agree from time to time. With no reliable data on the exact percentages of firebrick and coal-ash that react chemically under actual boiler conditions, there is no reliable guide for comparison. The results secured do not coincide with practice inasmuch as the high-iron ashes do not give the most pronounced results. The refractories do not group themselves in any definite order.

This brief paper is a valuable contribution to the literature, but perhaps its most significant finding is that the matter is still very much of a problem that has yet to be solved.

Water Versus Oil as a Hydraulic Turbine Governor Fluid

In a recent report of the Hydraulic Power Committee of the National Electric Light Association, it is stated that one large hydro-electric installation has used water as a governor fluid for eleven years. The quality of water available for this purpose is quite important. In this case its quality is excellent, being pure and clear, although it corrodes iron and steel slightly.

The makeup water is passed through a sand filter and part of the recirculated water is also passed through the same filter, although the greater part of the latter is passed through a very fine strainer. A duplicate fine strainer covered with a few layers of cheesecloth is installed on the small pipe line to the pilot valve to insure that no particles of appreciable size reach the pilot valve. These cloths are changed weekly.

In this installation monel metal is used for all parts of the pilot and relay valves, which gives better results than bronze. Another large installation makes use of a 1 per cent oil emulsion, using a soluble oil.

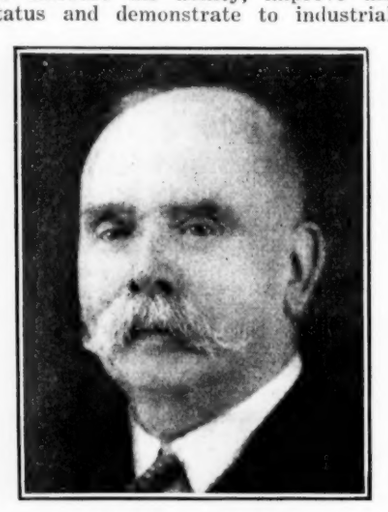
What the E. M. B. F. Is Doing for Canadian Engineers

FOR many years Canadian engineers have felt the steadily growing need of a well founded co-operative association, based on such principles as would materially better the status of the individual member through increased efficiency, and aid him in times of sickness in accordance with a balanced plan of mutual insurance. This, then, is the story of the fraternal ideals of a number of Canadian engineers, the materializing of those ideals two years ago, and the likely progress that is at present being made toward their realization.

With twenty-two charter members the latest branch of the Engineers' Mutual Benefit Fund, the Canadian counterpart of the N.A.S.E., came into being Nov. 12 as Hamilton Lodge No. 3, under the presidency of W. G. Beaver. And at this point no better summary of the objective of the E.M.B.F. could be presented than the statement by Campbell Bradshaw, chairman of the board of directors and managing editor of *Power House*. He writes:

Improved Status Is Aim of E.M.B.F.

"To get engineers together in a spirit of co-operation is, today, an absolute necessity if the occupation is not to sink to the lowest depths because of apathy and the inroads of predatory persons. Today the engineer is the poorest paid worker in Canada, when the value of the equipment entrusted to his care is taken into consideration. To increase his ability, improve his status and demonstrate to industrial



Walter J. Hudson

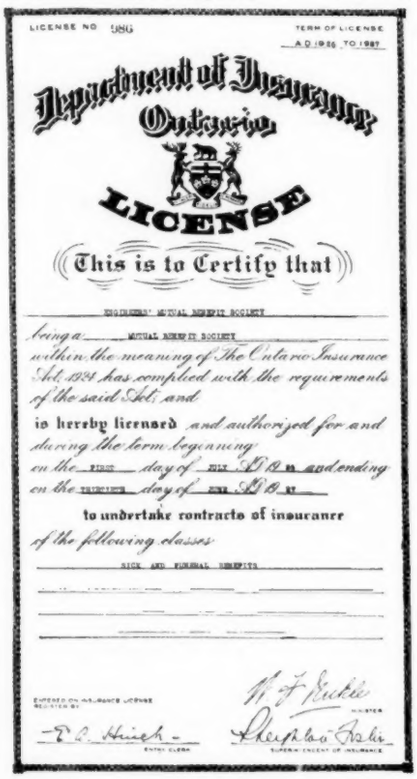
executives just what he is saving them in production costs, are all parts of the E.M.B.F. program."

So, with such ideals, the Engineers' Mutual Benefit Fund was conceived and founded at Toronto in April of 1926. To promote engineering knowledge, improve the status of power engineers and the efficiency of the plants entrusted to their care, and to extend relief to members in sickness or destitution and to their families in the event of death, is the business of this Canadian society, which already numbers five hundred members.

With enthusiastic workers in every province of the Dominion and three branches now in full operation, one of which, at Toronto, answers a roll-call of nearly 300 names, the E.M.B.F. is well on the road to finances and membership in 1927 needed to push forward its aims.

Founding and Development of the Society

The Engineers' Mutual Benefit Fund is, in large measure, the outcome of the action of the delegates to the June,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Department of Insurance
Ontario

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This is to Certify that

ENGINEERS' MUTUAL BENEFIT SOCIETY

being a MUTUAL BENEFIT SOCIETY within the meaning of The Ontario Insurance Act, 1924, has complied with the requirements of the said Act, and is hereby licensed and authorized for and during the term beginning on the FIRST day of JULY A.D. 1926 and ending on the THIRTIETH day of JUNE A.D. 1927 to undertake contracts of insurance of the following classes

SICK AND FUNERAL BENEFITS

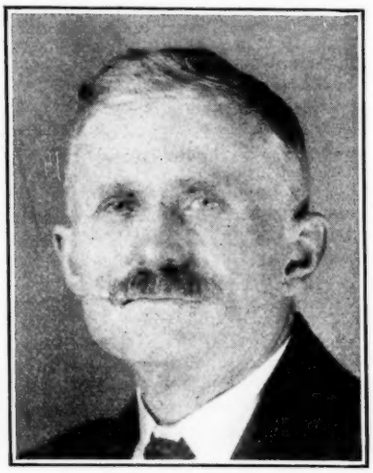
W. F. Rickle
REGISTRAR

D. C. Hinch
ENTRY CLERK

Stephen Fisher
SUPERINTENDENT OF INSURANCE

1925, convention at Windsor of the now defunct Canadian Association of Stationary Engineers. At the business session the decline of that organization was frankly discussed, and seven men were appointed to devise ways and means of creating a society of mutual benefit. These founders were: George A. Brown and Robert McLaren, of Toronto; F. A. Pflug, of Kitchener; George Galloway, of London; D. L. Webster, of Leamington; George Turnbull, of Windsor, and Campbell Bradshaw, of Toronto. The creation of such a body was no light undertaking, and with this in mind the men at the head put their heads to the task of providing substantial benefits to members at such a rate as is well within the purse of the poorest paid engineer, but at the same time establishing sound dues.

After several months of further study a meeting was held at Toronto, when it was unanimously decided to include in the ranks of the association engineers of all grades, races and creeds. Then followed preliminary steps to launch such a body, self-governing, self-sustaining, modern in its



Robert McLaren

principles of education and efficiency, in spirit as in name, the Engineers' Mutual Benefit Fund. Dues, benefits and other phases of the project were decided upon the agreement that sickness and funeral expenses would be paid and loans made to unemployed members to whatever extent the funds set aside for such a purpose might warrant. With the constitution and by-laws approved by the provincial secretary and a license to operate issued by the government, the profile of Archimedes, Greek mathematician and first reputed power engineer, was set up as the emblem of the E.M.B.F. June 1, 1926. At this time two well-known power engineers, F. A. W. Taylor and W. J. Hudson, were added to the provincial board of directors.

Legislative Reform an Important Field for Activity

In legislative matters, this association has found an important field for its activities. An instance of this service to power engineers occurred last November, when it succeeded in having power engineers exempted from provisions of the bylaw of governing electrical workers in Toronto which otherwise would have continued to compel an engineer who did any electrical repair work around his plant to stand an examination and obtain a yearly license. Great credit is due the successful financing of Robert McLaren, treasurer of the organization.

Better service to employers and substantial welfare for its members will be the deserved success of the E.M.B.F.

Recent Publications

Marvels of Modern Mechanics. By H. T. Wilkins. Published by E. P. Dutton & Co., New York, 1927. Cloth, 6x8½ in.; 280 pages, illustrated. Price, $3.

This volume is true to its title. It speaks of marvels and wonders in a manner to appeal to the uninformed popular mind. The engineer will have little to learn from a book of this sort, but his ten-year-old son would doubtless find it very absorbing and in a measure informing. The examples of modern mechanics are practically all drawn from British engineering development.

Bibliography of Magnesite Refractories. Bibliography of Silica Refractories. Bibliography of Literature on Refractories. Compiled by members of the Refractories Division, American Ceramic Society, and published by the Society, 2525 No. High St., Columbus, Ohio. Paper covers, 6¼x9¼ in., 41, 125 and 166 pages, respectively. Price, $2 for the set of three.

These bibliographies cover their fields fully, beginning with the older "classic literature" and covering the last quarter-century in detail. Nobody concerned with the technical information underlying the manufacture and use of refractories can afford to be without these valuable lists. Indexes facilitate finding items.

Zur Sicherheit des Dampfkesselbetriebes (The Safety of Steam Boiler Plants). Prepared by the Vereinigung der Groszkesselbesitzer E. V. Published by Julius Springer, Berlin, Germany, 1927. Cloth; 8¼x11¾ in.; 189 pages; profusely illustrated. Price, RM 28.50.

This volume is a collection of chapters by various engineers setting forth the physical properties of boiler plate and tubes, the methods employed in their manufacture, the testing of such materials, recent contributions to the study of intercrystalline cracks, the influence of feed water and methods of treating it, with a final chapter on safety in the high-pressure boiler installation. The volume is splendidly printed, especially the numerous metallurgical macro- and micro-photographs, showing the results of various etchings for displaying the structure of strained metal. These contribute greatly to its value to the boiler designer and operator, for whom the book should be a valuable compilation of up-to-date information.

Graphic Charts in Business. By Allan C. Haskell. Second Edition. Published by Codex Book Company, Inc., 461 Eighth Ave., New York City, 1926. Cloth, 5½x8 in.; nearly 300 illustrations. Price, $4 net postpaid.

The publication of the second edition of this book is an opportunity to bring it to the attention of engineers and others who have not seen the first edition, published in 1922. Designed primarily to initiate business men into the mysteries of chart making, "Graphic Charts" should be of considerable value to engineers whose training along this line has been neglected. Even the graduate engineer is likely to be unfamiliar with the use of probability paper, which is nicely explained. He will understand logarithmic rulings in a general way, but may easily pick up some new and worth-while ideas in this connection. The same applies to other and simpler types of charts, for which the illustrations suggest many novel uses. The book involves no mathematical knowledge beyond arithmetic and but little of that. Little attention is given to the design of mathematical charts for the solution of formulas. The subjects covered include plain and ratio rulings, choice of scales, use of ratio charts, bar charts, progress charts and calculating charts, together with a great variety of illustrative material, chiefly from industrial and commercial sources.

Fusibility of Coal Ash as Related to Clinker Formation. By W. A. Selvig and P. Nicholls, of the United States Bureau of Mines, and W. L. Gardner and W. E. Muntz, of the Carnegie Institute of Technology, with an introduction by E. B. Ricketts, Research Engineer of the New York Edison Co. Published by the Carnegie Institute of Technology, Pittsburgh, Pa., 1926. Paper covers; 6x9 in.; 64 pages; illustrated. Price, 50 cents.

This bulletin is the first report of a study undertaken at the request of the Committee on Coal and Coke, of the American Society for Testing Materials, with the object of determining the relation between the fusibility of coal ash and clinker formation in the fuel bed of furnaces. The investigation was undertaken for the purpose of determining some property of coal ash susceptible to reasonably accurate measurement in the laboratory, which would serve as an index to its clinkering characteristics in boiler furnaces. The importance of the solution of this problem to consumers and producers of coal is obvious.

Seven coals, having ash-fusion temperatures ranging from 2,070 to 2,930 deg. F., were selected for comparative burning tests in a specially designed hand-fired furnace with a circular grate 20 in. in diameter, and with water-cooled iron walls.

The following tentative consclusions may be drawn from the work done during the past year:

1. The average quantity of clinker formation relative to the total ash in the coal, and also the size of the clinker pieces, seems to have a fairly definite relation to the softening temperature of the coal ash, as determined by the standard gas-furnace method.

2. This relation is better expressed by using the softening temperature than it is by that of the initial or fluid temperatures.

3. No better relation can be obtained from the softening temperatures of the ash of the float-and-sink portions of the coal separated by fine grinding and using a liquid of 1.35 specific gravity.

4. The clinker formation does not increase materially until the softening temperature of the coal ash is below 2,600 deg. F.

The report gives extended tables and a number of tests of curves showing the observations supporting these conclusions.

Smoke Abatement Investigation at Salt Lake City, Utah. Bulletin 254 of the United States Bureau of Mines, by Monnett, Perrott and Clark, is an 80-page report discussing all phases of the work at Salt Lake City. Considerable space is given to the important subject of residence smoke. The use of coke for this service is urged. The bulletin is a valuable addition to the literature.

Characteristics of Pyrometric Cones. By C. O. Fairchild and M. F. Peters. Reprinted from the Journal of the American Ceramic Society. Size, 6x9 in.; 42 pages.

Those who are concerned with the determination of the melting point of coal ash and similar substances will doubtless be much interested in this discussion of an experimental investigation of the properties of Seger Cones, under a large variety of operating conditions.

Water Powers of Manitoba. The Dominion Water-Power and Reclamation Service of Canada has recently issued a report on the water powers of the province of Manitoba. This report contains a brief description of the main physical features, river systems and power resources of the province, outlines the procedure to acquire a license for water-power development under the Dominion regulations and the terms and conditions of such licenses, and gives statistics of the existing hydraulic installations in Manitoba and the undeveloped power on each river in the province. The estimates of undeveloped power are based chiefly on the surveys carried out by the Department of the Interior during the last fifteen years, and, although subject to revision, as more is learned of the flow characteristics of the various rivers, are of sufficient accuracy to give a clear idea of the power possibilities of the province. Copies of this report may be obtained free, on application to the Director of the Dominion Water-Power and Reclamation Service, Ottawa, Canada.

The Engineering Index for 1926.—The American Society of Mechanical Engineers has brought out a selective, cross-referenced digest to more than 1,100 engineering magazines, thus affording a means for locating every worthwhile article on any engineering subject published in the technical press during the past calendar year. The 1926 edition will be ready for distribution in April. With the information given in the reference readers can secure the articles from publishers.

News in the Field of Power

National Fuels Session Under A.S.M.E. Divisions Plan

According to a new policy, the professional divisions of the A.S.M.E. will hold national meetings. One of the first of these will be a National Fuels Meeting, fostered by the Fuels Division. This meeting will be held in St. Louis next October. It is expected that Chas. M. Schwab, president of the Society, will attend.

Victor J. Azbe, a member of the executive committee of the Fuels Division, has been appointed general chairman of the arrangements committee. Mr. Azbe already has the program outlined. It is planned to make this a three-day session.

Although this meeting will be sponsored by the Fuels Division and the St. Louis Section, many other organizations will co-operate, including these: American Boiler Manufacturers' Association; St. Louis Section, American Ceramic Society; St. Louis Chapter, American Society of Heating & Ventilating Engineers; National Warm Air Heating & Ventilating Assn.; St. Louis Coal Merchants Assn.; Coal Operators of Inner Group and of Southern Illinois; Lime Industry; Cement Industry; Citizens' Smoke Abatement League; American Stoker Manufacturers' Assn.; St. Louis Section, American Institute Mining and Metullargical Engineers; St. Louis Subordinate, National Association of Practical Refrigerating Engineers; Engineers' Club of St. Louis; St. Louis Section, American Institute of Electrical Engineers.

PAPERS NOW ON PROGRAM

The following papers have already been secured for the meeting:

"Characteristics of Modern Stokers," F. H. Daniels, president, Riley Stoker Co., Worcester, Mass.; "American Fuel Resources," O. P. Hood, chief mechanical engineer, U. S. Bureau of Mines, Washington, D. C.; "Combustion and Heat Transfer," Prof. R. T. Haslam, Massachusetts Institute of Technology; "The Measurement of Atmospheric Pollution, Visible and Invisible," Dr. George T. Moore, director, Missouri Botanical Garden, St. Louis, Mo.; "Characteristics of Modern Boilers," E. R. Fish, vice-president, Heine Boiler Co., St. Louis, Mo.; "Application of Powdered Fuel to Smaller Boiler Installations," H. W. Brooks, consulting engineer, Erie City Iron Works, Erie, Pa.; "Factors Governing the Purchases of Fuels," Morgan B. Smith, engineer, General Motors Corp., Detroit, Mich.; "Smoke Abatement Methods Used in Cleveland," Col. Elliott H. Whitlock, Commissioner of Smoke Inspection, Cleveland, Ohio; "Smokeless and Efficient Firing of Domestic Furnaces," Victor J. Azbe, consulting engineer, St. Louis, Mo., and "Managing a Smoke Abatement Campaign," by Erle Ormsby, president, Smoke Abatement League, St. Louis, Mo.

Many other papers by prominent engineers, not as yet received, will be offered at the meeting.

W. S. Hovey Elected New Head of Fairbanks, Morse & Co.

At the annual meeting of the directors of Fairbanks, Morse & Co., held in Chicago, March 29, W. S. Hovey was elected president, the former president, C. H. Morse, becoming chairman of the board. This is the first time this position has been held by a man not of the original Morse family.

Born in 1875, a graduate of Cornell,

W. S. Hovey

Mr. Hovey joined the Sheffield Car Co., an affiliation of Fairbanks-Morse, in 1902, as assistant superintendent. Later he became superintendent, which position he held until 1913, when he was transferred to the Beloit Works of Fairbanks-Morse as manager of the engine division, and was largely responsible for the development of the two-stroke-cycle oil engine which the company was starting to build. A few months later, saw him general manager of the entire Beloit works, in which oil and gas engines, pumps, windmills, etc., are manufactured.

In 1919, Mr. Hovey was elected vice-president in charge of all the manufacturing activities of Fairbanks-Morse and in 1924 was made general manager of the entire business.

The elevation of Mr. Hovey to the presidency brings a man to the helm of this company who has worked his way up through the ranks. His thorough grasp of all factors of this widely extended business makes him, in the opinion of his associates, well suited for the new office. He will remain general manager.

As announced April 1, the company has taken over the scale business of the Fairbanks Co. of New York.

In 1916 Fairbanks-Morse purchased E. & T. Fairbanks & Co., with its scale factories at St. Johnsbury, Vt., and East Moline, Ill. The Fairbanks Co. of New York, however, held the distributing rights for Fairbanks scales in the Eastern and Southern portions of the United States and abroad. The present transaction, therefore, gives Fairbanks-Morse complete control of the manufacturing and distribution of Fairbanks scales.

A scale manufacturing plant at Birmingham, England, as well as the London sales agency and all other sales agencies throughout the world, are included in the deal.

Colorado River Pact Sought by States as Agreeable

That Gov. George Dern of Utah has invited governors of seven other states to meet at Salt Lake City early in the summer for a conference on the development of the Colorado River, gives indications that a new eight-state compact, superseding the one from which Utah and Arizona withdrew, will be drawn. The Swing-Johnson bill, defeated in the last Congress by a spectacular filibuster, was based on the original seven-state pact.

California, Wyoming, Arizona and Colorado have tentatively accepted Governor Dern's invitation. Nevada, Arizona and New Mexico are the other states invited.

"All phases of the Colorado River project, power, reclamation and flood protection will be discussed at the conference," Governor Dern declared. "We shall probably outline a program for the future development of the Colorado River project that will be mutually agreable, if all the states attend."

Matters concerning the states' rights involved will be considered, exclusive of federal interests, according to the Utah executive. This is in line with an announcement made by Hubert M. Work, Secretary of the Interior, before the Colorado Legislature that a seven-member commission would be appointed soon to study the federal phases of the development project, to report to the Seventieth Congress next December.

Gov. G. W. P. Hunt of Arizona has expressed enthusiasm for the conference. Gov. Frank Emerson of Wyoming declared he would be willing to represent his state, but favored retention of the original pact.

"Nothing but a seven-state agreement would be acceptable to Colorado," said Gov. William H. Adams.

Penn State College Slates Oil Power Conference

An oil-power conference under the auspices of the Pennsylvania State College will be held at State College, Pa., April 21-23. It is the purpose of this conference to bring together manufacturers and users of engines on the one hand, and producers and refiners of oil on the other. Speakers representing the various groups will be present.

Details of the program have been so arranged that each group may learn from the discussions during the various sessions something of the problems of the others. The Thursday afternoon session will be devoted to papers of a general nature given by representatives of the oil men and the engine men. On Friday morning, an oil session will be held during which various phases of oil production and refining will be covered. Friday afternoon will take up questions of bearing design and lubrication and will be called the engine session. A public lecture by a well-known speaker will be given Friday evening on a topic of interest to the conference. On Saturday morning a session on oil sprays will cover that topic in detail, including the research being carried out at the College and that at Langley Field. The oil-spray research apparatus as well as the other equipment of the College will be open for inspection during the conference.

A final program will shortly be sent out, giving names of speakers and titles of papers. E. D. Ries is chairman.

New Patent Laws Simplify Present Procedure

Benefits conferred upon the public by the last session of Congress in the passing of some much needed legislation for the improvement of patent laws include changes which will lessen the time required in obtaining the grant of patents, and a simplification of the procedure in the Patent Office, and the courts, with a corresponding decrease in expense to the inventor, which have been advocated by some of the leaders in the patent profession for a number of years. The present changes in the law were indorsed by the American Bar Association at its annual meeting held at Denver, last July.

One of the most important advances made by the new law is the requirement that amendments must be filed by the inventor within six months following an action by an examiner. For a number of years past the inventor could allow his case to lie dormant for a year at a time. The cutting of this period in half will result in a great benefit in that the manufacturers, who supply the needs of the public, will, in the future, be informed of the trend of inventions in their respective lines with reasonable promptness.

The work in the Patent Office, especially with respect to the more important inventions which often become involved in questions requiring hearings on appeal, will be rendered more efficient under the new laws by an increase in the number of members of the Board of Appeals. In addition to this, one of the appeals formerly allowed to the Commissioner in person has been abolished, and the right given to the inventor to carry his case from the Board of Appeals direct to the Federal Courts.

A stride has been made in the interference practice (a proceeding in which two or more parties are contesting the question of priority of invention for the same subject matter) in that, in addition to eliminating one appeal in the Patent Office, the final appeal carries the interference into the Federal Courts, where the case may be presented on the same printed record that was used in the Patent Office, supplemented by further evidence which may be taken before the Court if such is desired.

Hereafter parties interested will be benefited by the knowledge obtained from the marking of patented articles with the number of the patent, instead of the date, as has been the previous custom. This will enable anyone to locate a patent in the *Official Gazette* quickly and accurately.

Exhibitors and Buyers Swarm at Leipzig Fair Opening

More than 10,000 exhibitors displayed their products at the opening of Leipzig Spring Fair, which officially began March 6. In some form or other a commercial and industrial fair has been held in this city twice annually for approximately 700 years. While, during the past century, the scope of the show grew but slowly, there being but 1,300 exhibits in 1897, the attraction of the exposition has grown with leaps and bounds since the World War, as evidenced by the fact that over 175,000 buyers from all parts of the world attended it in 1924. There is every indication that that number will be greatly exceeded this year.

Iowa Power Conference Held at State University

A power conference, of special interest to the State of Iowa, for the consideration of power resources, generation, transmission and utilization in that state, took place at the University of Iowa, Iowa City, March 30 and 31.

Water power in the state was the topic of an address and discussion by F. A. Nagler, associate professor of hydraulics and W. C. Tegtmeier. Power generation and transmission under Iowa conditions were discussed by H. R. Summerhayes, chief engineer of the central station department of the General Electric Co., and G. T. Shoemaker, electrical and mechanical engineer of the United Light & Power Co., Davenport, Iowa, and power plant interconnecting in Iowa, by A. H. Ford, professor of electric engineering and R. H. Garrison, Central Iowa Power & Light Co.

The university's interest in power was the subject of a talk by President Jessup. Phases of the utilization of Iowa coal considered by J. H. Lees, assistant state geologist, Don M. Sterns, president of the Central Iowa Power & Light Co., T. H. Marsh, Combustion Engineering Corp.

Carnegie Tech Offers Summer Courses in Engineering

Courses in engineering subjects, it is announced, are featured in the plans for the summer session this year at the Carnegie Institute of Technology in Pittsburgh, Pa. This summer work, according to plans, is being outlined to cover both theoretical class room instruction and shop practice, to appeal not only to the undergraduates, but also to those engaged in engineering work who feel a need for more technical training in their respective fields. Courses of six and eight weeks will be given, beginning June 13.

The College of Engineering will give courses in chemistry, physics, mechanics, surveying, and coal mining.

Obituary

Allan Stirling, noted boiler inventor and one of the original members of the A.S.M.E., died Feb. 3, 1927, at his home in Norfolk, Pa. His death was due to the infirmities of old age.

Mr. Stirling was born on July 25, 1844, at Rutherglen, Scotland. In 1860 he came to America and completed his education at the Cooper Institute in New York. In 1862 Mr. Stirling entered the emergency drafting office which the Navy Department established at Broadway and Franklin Streets, near the home of Capt. John Ericsson, where improved designs for monitors were being worked out. The young engineer was assigned to the design of the blowing engines which supplied air below decks and also worked out plans for gun carriages used in the turrets. At the end of the Civil War, Mr. Stirling spent a year in the machine shop of Anderson & McLaren in New York. At the end of that year he became a draftsman for the firm of Winslow, Griswold & Holley, in Troy, N. Y., in connection with the construction of the first bessemer steel works erected in the United States. When this task had been completed, Mr. Stirling remained in Troy as draftsman and superintending engineer for the Burden Iron Works, leaving them in 1878 to take charge of the mechanical department of the Metropolitan Elevated Railway in New York. In 1880 Mr. Stirling left the Elevated with the intention of becoming an engineering specialist. He designed and built for the Rathbun Co., at Deseronto, Ont., one of the earliest cable conveyors, and also laid out a foundry and machine shop for Coxe Bros., at Drifton, Pa. In 1883 Mr. Stirling interested his old friend Mr. DeLamater in a unique boiler which he had designed for a working pressure of 300 lb. per sq.in. One was built and operated at the DeLamater Iron Works, but proved to be somewhat "ahead of its" time and the design was given up. Following this experiment he became consulting engineer for the Rathbun Co. upon plant improvements, and in carrying out this work he installed boilers of his new design with certain refinements. The success of these led him to establish himself in the boiler business in

Canada. The design of the "Three-Drum Stirling" boiler came into his mind during a night ride on a Canadian train. This resulted in the well-known "Four-Drum Stirling" patented by him in 1892, for the manufacture of which the International Boiler Co. was established.

Mr. Stirling retired from active business several years ago, but still kept up his interest in the boiler business by designing an occasional boiler for an old customer and seeing that a supply of repair parts was maintained.

At the invitation of the late Alexander Holley, Mr. Stirling joined the A.S.M.E. at its inception in 1880 and presented a paper on steam boilers at its first meeting. He served as manager from 1881 to 1884 and as vice-president from 1885 to 1887. He was a life member of the Society.

Society Affairs

The New York Section of the American Works Association will hold its next meeting at Oswego, N. Y., May 5 and 6. E. D. Case, c/o The Pitometer Co., 50 Church St., New York City, is secretary.

Business Notes

The Boiler Tube Company of America was consolidated at its new building at 3125 Preble Ave., N. S. Pittsburgh, Pa., April 1.

The Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., according to a recent announcement, has taken over the entire Sprague portable hoist business of the General Electric Co. The change took place April 1.

The Homestead Valve Manufacturing Co. has appointed W. R. Ladewig, 238 So. San Pedro St., Los Angeles, Calif., as an exclusive factory representative in southern California. He will promote the sale of products in the general industrial plants, power plants and oil refineries in this district.

The Chicago Fuse Manufacturing Co., manufacturer of Union and Gem fuses and conduit fittings, announces the appointment of W. A. Wilcox as district sales manager with headquarters at St. Louis. Mr. Wilcox will have charge of sales over southern Illinois, eastern Missouri, western Tennessee, Mississippi, Arkansas and Louisiana. Prior to this appointment Mr. Wilcox was associated with the Economy Fuse & Manufacturing Co. for more than eight years.

G. E. Millner & Co., Ltd., of Parliament Mansions, Victoria Street, London, have secured control of the patent rights in the "PITMAN" deflector regulator for the automatic speed control of impulse water turbines and hydro-electric plant. General or exclusive licenses will be granted in the following countries: The United Kingdom, Canada, The United States of America, American Patent No. 1,608,565, France, Switzerland, Italy, Spain and Germany. Full information may also be obtained from the inventor, Percy Pitman, Water Turbine Manufacturer, 25 Victoria St., London, S. W. 1.

The Celite Products Co. announce the appointment of Clyde E. Beckett and George S. Holland as additions to the engineering staff of the concrete department at the Chicago office. Mr. Beckett was formerly with the L. E. Myers Co. of Chicago, and Mr. Holland was formerly in the engineering department of the City of Des Moines and later with the Harrison Construction Company, of Des Moines.

Coming Conventions

American Association of Engineers. Annual convention, Tulsa, Okla., June 6-8; M. E. McIver, 63 East Adams St., Chicago.

American Boiler Manufacturers Association. Annual meeting at French Lick Springs Hotel, French Lick, Ind., May 30-June 1.

American Eletrochemical Society. Silver jubilee meeting at Philadelphia, Pa., April 27-30; H. E. Dalling, sec., Columbia University, New York.

American Institute of Electrical Engineers. F. L. Hutchinson, secretary, 33 West 39th St., New York City. Bethlehem, Pa. regional meeting April 21-23, Pittsfield, Mass. regional meeting May 25-27. Summer convention at Detroit, Mich., June 20-24 inclusive; Pacific Coast convention at Del Monte, Calif., Sept. 13-16.

American Oil Burner Association. Annual convention and exposition at Buffalo, N. Y., April 5-7.

American Order of Steam Engineers. Annual convention, Moose Hall, 1314 North Broad St., Philadelphia, Pa. June 13-16; J. E. Burke, 1821 So. Ringgold St., Philadelphia.

American Refractories Institute. Spring meeting at Hotel Traymore, Atlantic City, N. J., May 18-19; D. A. Texter, secretary, 2202 Oliver Bldg., Pittsburgh, Pa.

American Society of Civil Engineers. George T. Seabury, secretary; Spring convention at Asheville, N. C., April 20-22. Annual convention at Denver, Col. July 13-15.

American Society of Mechanical Engineers. Spring meeting at White Sulphur Springs, W. Va., May 23-26. Calvin W. Rice, secretary. Midwest regional meeting will be held in Kansas City, April 4-6 inclusive; F. S. Dewey, chairman of the Kansas City Section.

American Society of Refrigerating Engineers. Western meeting at White Sulphur Springs, W. Va., May 23-25, in conjunction with the Spring meeting of the A.S.M.E.; W. H. Ross, 35 Warren St., N. Y.

American Society for Testing Materials. Annual convention at French Lick Springs Hotel, French Lick, Ind., June 20-24; J. K. Rittenhouse, secretary, 1315 Spruce St., Philadelphia, Pa.

American Water Works Association. W. M. Niesley, assistant secretary, 170 Broadway, N. Y. Annual convention Hotel Sherman, Chicago, June 6-11.

American Welding Society. Annual meeting at 29 West 39th St., New York City, April 27-28-29.

Association of Iron and Steel Electrical Engineers. Annual convention at Pittsburgh, Pa., June 13-18, inclusive.

National Association of Practical Refrigerating Engineers. Annual convention probably in November; E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Association of Stationary Engineers—Annual convention at Ambassador Hotel, Los Angeles, Calif., Aug. 22-27; John Topman, secretary, convention committee, Ohio State annual convention in Memorial Hall, Lima, Ohio, June 16-18; P. H. Grigsby, secretary, Lima, Ohio. New England States convention at Portland, Me., June 17-18; Thomas H. Clark, president, Worcester, Mass.; Robert Johnson, secretary, 65 Charlotte St., Worcester, Mass. Indiana State convention and power show at Anderson, May 27-28.

National Board of Boiler and Pressure Vessel Inspectors. Annual meeting at Nashville, Tenn., June 8.

National Electric Light Association. A. Jackson Marshall, secretary, 29 West 39th St., New York City. Convention at Atlantic City, June 6.

Universal Craftsmen Council of Engineers. Thomas H. Jones, secretary, 33 Linden Ave., Cherrydale, Va. Annual convention at Buffalo, N. Y. Aug. 2-6.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	Mar. 28 1927
Pool 1	New York	$2.75@$3.25
Smokeless	Boston	1.70
Clearfield	Boston	1.65@ 2.00
Somerset	Boston	1.80@ 2.15
Kanawha	Columbus	1.40@ 1.75
Hocking	Columbus	1.65@ 1.75
Pittsburgh	Pittsburgh	2.00@ 2.10
Pittsburgh gas slack	Pittsburgh	1.60@ 1.70
Franklin, Ill.	Chicago	2.50@ 2.75
Central, Ill.	Chicago	2.00@ 2.25
Ind. 4th Vein	Chicago	2.40@ 2.50
West Ky.	Louisville	1.40@ 1.75
S. E. Ky.	Louisville	1.40@ 1.65
Big Seam	Birmingham	1.50@ 2.00
Anthracite Gross Tons		
Buckwheat No. 1.	New York	2.50@ 3.00
Buckwheat No. 1.	Philadelphia	2.50@ 3.50
Birdseye	New York	1.60@ 1.85

FUEL OIL

New York—March 31 light oil, tank-car lots; 28@34 deg. Baumé, 5¾c. per gal.; 36@40 deg., 6c. per gal. f.o.b. Bayonne, N. J.

St. Louis—March 24, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.95 per bbl.; 26@28 deg., $2.00 per bbl.; 28@30 deg., $2.05 per bbl.; 30@32 deg., $2.10 per bbl.; 32@36 deg., gas oil, 5.5c. per gal.; 38@40 deg., 6.25c. per gal.

Pittsburgh—March 15, f.o.b. local refinery; 30@34 deg., fuel oil, 6¼c. per gal.; 36@40 deg., fuel oil, 6.5c. per gal.

Philadelphia—March 23, 27@30 deg., $2.52@$2.58 per bbl.; 13@19 deg., $2@$2.06 per bbl.

Cincinnati—March 28, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago — March 26, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.20 per bbl.; 26@30 deg., $1.30; 30@32 deg., $1.55.

Boston — March 28, tank-car lots, f.o.b. 12@14 deg. Baumé, 4¾c. per gal.; 28@32 deg., 6c. per gal.

Dallas—March 19, f.o.b. local refinery, 26@30 deg., $1.75 per bbl.

Trade Catalogs

Dionic Water Testers—James S. Biddle, 1211 Arch St., Philadelphia. Bulletin 1125, portable direct reading instrument for testing condenser leakage and the concentration of boiler water as a basis for blowdown control, and for other uses depending upon the determination of the electrolytic conductance of dilute solutions.

Scales—The Toledo Scale Co., Toledo, Ohio, has published a descriptive booklet of automatic scales, embodying six late improvements, designed for various types of service.

Devices for Removing Moisture, Oil and Dirt in Compressed Air—W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa. Separator style "A" is designed for small air lines from ¼-in. to ¾-in. inclusive, and to be placed in lines close to where air is taken off to feed pneumatic tool, air brushes, soapstone sprays, etc. If it is desired to drain these separators automatically, a number can be piped. Style "B" is for air lines from 1-in. to 2-in. inclusive. It can be automatically drained by a Nicholson No. 1 weight operated trap. It is also adapted for use on sand blasts, molding machines, etc. Style "C" is designed for all air lines from 1½-in. to 12-in., and to be automatically drained by either the Nicholson weight or piston operated traps. Prices and dimensions for the three styles are tabulated.

Diesel Engines—De La Vergne Machine Co., 979 East 138th St., New York City, has issued bulletins entitled "Non Stop 457 Day Run De La Vergne Diesel Engine" and "What Diesel Engine Users Say."

Brands of Fire Brick and Other Refractories—The American Refractories Institute, Oliver Building, Pittsburgh, Pa., has compiled the seventh edition of its compendium of the brands of firebrick and other refractories, together with a list of manufacturers in the United States and Canada.

Unique Power House at Mystic Iron Works—The Freyn Engineering Co., 310 South Michigan Ave., Chicago, Ill., has issued in illustrated pamphlet form an article by Arthur J. Whitcomb, assistant electrical engineer of the company, on the power station of the Mystic Iron Works at Everett Mass. This paper is reprinted from *The Blast Furnace and Steel Plant* for Feb., 1927.

Electric Tools—The Black & Decker Manufacturing Co., Towson, Md., has issued its 1927 Catalog No. 14 on electric tools, which amply describes its products in the line of portable electric drills and stands, electric screwdrivers and socket wrenches, electric bench and pedestal grinders, electric twist-drill grinders, portable electric tappers, portable electric valve grinders, electric valve refacers and attachments, and accessories for the above listed tools. Specification tables are also included.

Economical Operation of Pump Stations—The De La Vergne Machine Co., 986 East 138th St., New York City, is distributing in illustrated booklet form an article on the economical operation of pump stations, by James H. Dameron, describing the Gulf Refining Co.'s stations in the Louisiana-Arkansas division of the Mid-Continent. This account is reprinted from this year's Jan. 13 issue of the *Oil and Gas Journal*.

Planing Mill Exhausters—The B. F. Sturtevant Co., Hyde Park, Boston, Mass., recently brought out Bulletin 303 describing planing mill exhausters of the slow-speed low power type. These slow-speed exhausters are particularly adapted for collecting and conveying shavings, sawdust, chips, dust from emery and buffing wheels and similar materials that can be conveyed in a current of air. In addition to information covering dimensions, weights, etc., there is a general performance table whereby the proper size of fan speed and horsepower can be determined for the average medium-sized exhaust installation, without the necessity of complicated mathematical calculations.

New Plant Construction

Ala., Montgomery — Capital City Hotel Co., plans the construction of an 11 story hotel. Estimated cost $1,000,000. Architect and engineer not selected.

Calif., Berkeley—H. J. Heinz Corp., c/o Austin Co., 777 East Washington St., Los Angeles, Contr., awarded contract for the construction of a factory and power plant on Berkeley St., here. Estimated cost $300,000.

Calif., Long Beach — Ford Motor Co., Highland Park, Mich., is having plans prepared for the construction of an assembly plant including power house, etc., here. Estimated cost $500,000. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., is architect.

Calif., Los Angeles—Baldridge Packing Co., c/o J. M. Cooper, Rives-Strong Bldg., Contr., awarded contract for the construction of a packing plant, boiler house and refrigeration plant on East Vernon Ave. Estimated cost $60,000.

Calif., Los Angeles—County is having preliminary plans prepared for the construction of a group of hospital buildings including boiler house and refrigeration plant. Estimated cost $150,000. Allied Architects Assn., Citizens National Bank Bldg., is architect.

Calif., Los Angeles — E. L. Mayberry, Transportation Bldg., Archt., will soon receive bids for the construction of a 13 story office and stores building including steam heating system at First St. and Broadway, for R. B. MacIntosh, 3827 Hyans St.

Calif., Ramona — Ramona Irrigation Dist. is having plans prepared for waterworks improvements including booster pumping plant, etc. T. K. King, 920 8th St., San Diego, is engineer.

Calif., San Francisco—Y.M.C.A., Leavenworth & Golden Gate Aves., awarded contract for the construction of a 15 story hotel at Turk and Leavenworth Sts. to K. E. Parker, 135 South Park St., Estimated cost $800,000.

Calif., Tulare—City plans the construction of a power plant.

Conn., Danbury—North Shore Properties Co., 114 Amity St., Flushing, N. Y., will soon receive bids for the construction of an apartment building here. Estimated cost $750,000. A. J. Thomas, 2 West 46th St., New York, N. Y., is architect.

Ga., Albany — City voted $50,000 bonds for waterworks improvements including artesian well, pumping equipment, mains, etc.

Ill., Chicago—W. Bernhard & Co., 820 Tower Ct., Archts., will soon receive bids for the construction of a 12 story hotel including steam heating system, mechanical refrigeration plant, elevators, etc., at 6151 Winthrop Ave., for Syndicate, c/o E. F. Techmer, 2441 Sunnyside Ave. Estimated cost $1,081,000.

Ill., Chicago — Chicago Mercantile Exchange, 136 West Lake St., awarded contract for masonry, etc., for a 17 story produce exchange and office building at Washington and Franklin Sts., to Paschen Bros., 111 West Washington St. Estimated cost $3,500,000. A. S. Alschuler, 28 East Jackson Blvd., is architect.

Ill., Chicago—H. J. Marlowe & J. Horwotz, 10 South La Salle St., will build a theatre and stores building including cooling plant, etc. at Eggleston Ave. and West 119th St. Estimated cost $600,000. G. E. McClellan, 7441 Cottage Grove Ave., is architect. Work will be done by separate contracts. Owner is general contractor.

Ill., Chicago — Syndicate, c/o Omar & Lilienthal, 64 West Randolph St., Archts., is having plans prepared for the construction of a 20 story hotel including steam heating system, elevators, etc. at Ohio and St. Clair Sts. Estimated cost $3,000,000.

Ill., Chicago — J. A. Wetmore, Acting Supervising Architect, Treasury Dept., Washington, D. C., will receive bids until Apr. 14 for extensions and improvements to power house, etc., at U. S. Marine Hospital, here.

Ill., Waukegan—HiWay Hotel Co., is having plans prepared for the construction of a 9 story hotel at Washington and Utica Sts. Estimated cost $500,000. B. K. Gibson, 624 South Michigan Ave., Archt.

Ind., Michigan City—Pottawattomie Park Club, F. R. Warren, Pres., is having preliminary plans prepared for the construction of a hotel. Estimated cost $1,000,000. D. Klafter, 201 East Ontario St., Chicago, Ill., is architect.

Ia., Sioux City—Frances Building Co., awarded contract for the construction of a 7 story theatre and office building to Kaiser-Ducett Co., Joliet, Ill. Estimated cost $850,000.

Ky., Louisville — F. G. Breslin, 1289 Cherokee Rd., will soon award contract for the construction of a 6 story store and office building at Third St. and Broadway. Estimated cost $600,000. Joseph & Joseph, Francis Bldg., are architects.

Mass., Canton—Edison Electric Illuminating Co., 39 Boylston St., Boston, awarded contract for the construction of power plant on Revere St., here, to Simpson Bros. Corp., 77 Summer St., Boston. Estimated cost $40,000.

Mich., Detroit—Twentieth Century Club, I. Hurst, Pres., 62 East Columbia St., is having plans prepared for the construction of a 9 story hospital including steam heating and refrigeration systems, boilers, elevators, etc. Estimated cost $3,000,000. Architect not announced.

Miss., Biloxi—City will soon award contract for waterworks improvements including two pumping stations, mains, etc.

Mo., Kansas City—W. D. Snyder, 817 Commerce Bldg., plans the construction of an 11 story hotel at Linwood Blvd. P. T. Drotts, 423 Reliance Bldg., is architect.

Mo., Kansas City—Ward Investment Co., 812 Pioneer Trust Bldg., is having preliminary sketches made for the construction of an apartment building at 51st and

Wornall Rd. Estimated cost $1,000,000. Lucke & Lucke, Ovar Leslie Bldg., are architects.

Neb., Blair—City will soon receive bids for extensions and improvements to electric light and power plant. Estimated cost $35,000. Pillsbury Engineering Co., 2344 Nicollett Ave., Minneapolis, Minn., is engineer. Equipment will be required.

Neb., Fremont—City, awarded contract for the construction of a power plant to Henry Ohlsen & Sons, David City. Estimated cost $87,600.

N. J., Elizabeth—Alber Leon & Son, 95 Smith St., Perth Amboy, N. J., will soon receive bids for the construction of a 7 story hotel including elevators, on East Jersey St., here. H. O. Hamilton, 342 Madison Ave., New York, N. Y., is architect.

N. Y., Bellport—Patchogue Electric Light Co., South Ocean Ave., Patchogue, has been granted permit by Public Service Commission to construct an electric light plant here.

N. Y., Brooklyn—American Hard Rubber Co., College Pt., awarded contract for the construction of a power plant here, to Walter Kidde, 140 Cedar St., New York. Estimated cost $200,000.

N. Y., Brooklyn—Bush Terminal, Ft. 43rd St., had plans prepared for the construction of a power plant on 34th St. Estimated cost $850,000. Stevens & Wood, Inc., 120 Broadway, New York, are engineers.

N. Y., New York—Forty Two-Forty Four West Thirty Ninth St. Corp., c/o Buchman & Kahn, 49 West 45th St., Archts., is having plans prepared for the construction of an 8 story office building including steam heating system, elevators, etc. Estimated cost $500,000.

N. Y., Yonkers—The Alexander Smith & Sons Carpet Co., Elm and Palisades Aves., awarded contract for the construction of a 49 x 50 ft. power plant to Turner Construction Co., 244 Madison Ave., New York.

O., Dayton—Van Cleve Hotel Co., plans the construction of a 12 story hotel at First and Ludlow Sts. Estimated cost $1,000,000. Frank Hill Smith & Co., Winters Bank Bldg., are architects and engineers.

O., Millersburg—City Council, will receive bids until Apr. 15 for waterworks improvements including pump house, mains, etc. Estimated cost $25,000. D. M. Schoer, Dover, is engineer.

O., Springfield—Bd. of Trustees, Wittenberg University, is having plans prepared for the construction of a power plant. Estimated cost $55,000. H. D. Smith, 207 East State St., Columbus, is engineer.

O., Sandusky—W. F. Seitz, Jr., 224 Columbus Ave., will soon award contract for the construction of a theatre and office building. Estimated cost $500,000. Millot & Parker, Sandusky, O. and W. Whitney, 6951 South Green St., Chicago, Ill., associate architects.

Okla., Seminole — Oklahoma Pipe Line Co., Tulsa, had plans prepared for the construction of an oil pumping station including four pumps and natural gas pumping engines, etc., in Seminole oil field, here. Estimated cost $100,000. Private plans.

Okla., Tulsa—Exchange Trust Co., 14 East Third St., is having sketches made for the construction of a 21 story bank and office building. Weary & Alford, 1923 Calumet Ave., Chicago, Ill., are architects.

Ore., Portland—N. W. Howard & Associates, c/o Ritter-Lowe Co., Bd. of Trade Bldg., is having plans prepared for the construction of a 32 story apartment building at West Park, Jefferson, Madison and Park Sts. Estimated cost $5,000,000. L. L. Dougan, Kreamer Bldg., is architect.

Pa., Springdale — Duquesne Light Co., Philadelphia Co. Bldg., 6th Ave., Pittsburgh, will build a warehouse and power plant here. Estimated cost $50,000. Private plans. Work will be done by separate contracts.

Texas—Texas Plains Gas & Fuel Co., Wichita Falls, awarded contract for the construction of a natural gas line from Amarillo, Tex., to Kansas City, Mo., about 485 mi. including 13 booster pumping stations, etc., along the line to Hope Engineering & Supply Co., Mt. Vernon, O. Total estimated cost approximately $20,000,000.

Tex., Corpus Christi—City is having preliminary surveys made for waterworks improvements including reservoir, booster pumping station, pumping equipment, etc. Estimated cost $300,000. H. Levinson is city engineer. J. M. Moore, Mayor.

Tex., Flatonia—Central Texas Power & Light Co., Frost Bldg., San Antonio, has acquired the light plant of the Citizens Utility Co. and plans extensions and improvements here. Estimated cost $25,000. Private plans.

Tex., Houston—Southern Ice & Storage Co., will soon receive bids for the construction of a 75 ton ice plant on Clark St. Estimated cost $150,000. Architect and engineer not selected.

Tex., San Antonio—Merchants Ice & Cold Storage Co., E. Houston St., awarded contract for the construction of an ice and cold storage plant to L. T. Wright & Co., 912 Builders Exchange Bldg. Estimated cost $26,796.

W. Va., Mannington—City plans an election May 2 to vote $100,000 bonds for the construction of a complete waterworks system including well, pumps, etc.

Ontario — Hydro Electric Power Commission of Ontario, 190 University Ave., Toronto, plans increasing transformer capacity at Thorold, Welland, London, Preston, Stratford, St. Marys, St. Thomas, Brant, Guelph, Hamilton and Toronto. Estimated cost $1,500,000. F. A. Gaby, 190 University Ave., Toronto, is chief engineer.

Ont., Toronto—J. Eaton Co. Ltd. 190 Yonge St., plans the construction of a manufacturing plant including steam heating system, elevators, etc. Estimated cost $3,000,000. Architect and engineer not selected.

Que., Montreal—Bd. of Governors, Notre Dame Hospital, Sherbrooke St., will soon receive bids for the construction of addition to hospital and nurses' home. Estimated cost $1,250,000.

Equipment Wanted

Air Compressor, Etc.—City of Akron, O., will receive bids until Apr. 7 for an air compressor, etc., for proposed sewage disposal plant now under construction.

Boiler and Engine—M. Judd & Son, Fellsway and Second Sts., Medford, Mass., is in the market for a 75 to 100 hp. steam engine and boiler.

Boilers, Pumps, Stokers, Etc.—State Division of Architects and Engineers, Capitol Bldg., Springfield, Ill., will receive bids until Apr. 26 for boilers, stokers, pumps, engines, electric switchboard, coal bunkers, coal conveying plant, etc., for Watertown State Hospital, East Moline, Ill.

Engine, Motor and Switchboard—F. C. McRaney, Clk., Collins, Miss., will receive bids Apr. 5, for a 180 hp. oil burning engine connected to alternator and exciter, motors, switchboard, etc.

Gas Engine, Generator and Switchboard—Bd. of Trustees of Public Affairs, Citizens National Bank Bldg., Caldwell, O., will receive bids until Apr. 14 for one 300 to 400 hp. gas engine, a.c. generator and switchboard for electric light plant.

Gasoline Engine—D. H. Key, Box 172, Fort Hunter, N. Y., is in the market for a 12 hp. portable gasoline engine.

Motor, Etc.—New Castle Levy Court, Wilmington, Del., will receive bids until Apr. 12 for an operating motor, controller and gearing for Seventh St. bridge, over Brandywine Creek.

Motors, Etc.—Port Commission of Houston, Houston, Tex., will receive bids until Apr. 7, for motors, trippers, spouts, etc. for grain elevator carrier house. Estimated cost $50,000.

Pump and Motor — D. A. Bane, Clk., Healdsburg, Calif., is receiving bids for a 1,200 g.p.m. motor driven centrifugal pump unit, 200 ft. head, direct connected to a 100 hp. motor, 3 ph., 60 cycle, r.p.m. squirrel cage with 125-200 hp. starter.

Pump and Motor—City of Amarillo, Tex., will receive bids after Apr. 5 for a centrifugal pump and motor for sewage pumping station. Estimated cost $25,000.

Pump and Motor—W. J. Richards, Water Supt., Orange, Tex., plans the installation of a deep well pump, and electric motor in well No. 4.

Pumps and Motors—R. L. Jones, Clk., New Madrid, Mo., will receive bids until Apr. 14 for two 150 g.p.m. vertical centrifugal pumps with motors and starters for sewage pumping plant.

Pumps, Switchboard, etc.—Dept. of Public Works, Bureau of Water, Philadelphia, Pa., will receive bids until Apr. 7 for four motor driven pumps for Belmont high service station, also switchboard for Chestnut Hill pumping station and boiler baffles for six 500 hp. boilers and appurtenant work.

Pumping Equipment — Bd. of Public Works, J. H. Wineland, Pres., Elkhart, Ind., will receive bids until Apr. 8 for pumping equipment for proposed waterworks improvements.

Pumps, Motors, Switchboard, Etc.—Constructing Quartermaster, c/o H. F. Ewing, Ft. Sam Houston, San Antonio, Tex., will receive bids until Apr. 15 for several centrifugal pumps, electric motors, switchboard, etc., to be installed in pumping plant. Estimated cost $18,000.

Refrigeration Plant—Constructing Quartermaster, Fort Mason, San Francisco, Calif., is receiving bids for a 5-ton refrigeration plant for Fort McDowell.

Transformers—H. R. Smith, Clk., Azura, Calif., plans to purchase three new kva. single ph. 50 cycle, 11,000 v. primary, 460-230 v. secondary transformers and three used 100 kva. single ph. 50 cycle, 16,500 v. primary 460-230 v. secondary type 11 K. O. C. Wagner Electric Mfg. Co. transformers.

Turbines, Generators, Transformers, Etc.—Turlock Irrigation Dist., A. Sorensen, Secy., Turlock, Calif., will receive bids until Apr. 19 for turbines, generators, transformers, switches, motor generator sets, etc., for two 7,500 kw. units at Don Pedro power plant.

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